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AN ILLUSTRATED

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PLAINLY WORDED - EXACTLY DESCRIBED

CONDUCTED BY RICHARD A. PROCTOR.

"LET KNOWLEDGE GROW FROM MORE TO MORE"—*Tennyson.*

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OUR BOYS AT SCHOOL.

BY RICHARD A. PROCTOR.

THE death of one of the boys at King's College School, through ill-treatment by his fellows, will probably have been inquired into fully, and the matter disposed of, before these lines are read. But in any case my remarks will be general, and such as could be properly made while the matter is still *sub judice*.

It appears to me that the question of school discipline is one which needs very careful study in Great Britain. If there is one article of national faith which the Briton of the top-boot type regards as sacred, it is that our public schools are noble institutions where the best and bravest types of British manhood were formed. It has always seemed to me, however, that if our public school system fails to turn any boy subjected into a cross between the bully and the sneak, it can only be because the boy has a singularly good disposition by nature, and because his school has fortunately been under the control of an exceptionally strong and able ruler. Many talk as though such work as Arnold and Temple did at Rugby had been done once and for ever—as though bullying had been killed because it was scotched there and then. Unfortunately, this is far from being the case. Bullying is literally *encouraged* by our public school system, just as slavery was encouraged of old in America. It is made worth a boy's while to become a bully as soon as he can escape being bullied. If he is of too good a nature to learn the art of bullying, he comes off worse than boys of coarser disposition. If a head-master can make bullies wretched by developing a brave and manly tone, the mischief may for a while be checked, or even stopped altogether. But the evil of the system remains.

This is a serious matter. Fathers of families commit their boys, at a time when as yet the character is unformed, to emphatically evil influences. Unfortunately, they have scarce any choice in the matter. As social and business life is constituted, and must be constituted, in all busy communities, a man cannot take charge or even watch over the education of his boys. Then boys cannot be properly trained for the struggle of life at home, or even, perhaps, as private pupils, "where only a limited number can be received," an arrangement which is often as disastrous in its results as public school training can be. A man has to send his boys either to a public school or to some private school, which may or may not be a good one.

What we want is an overhauling of the whole system of our public schools, and indeed of all our schools. The savage idea underlying the working part of the system, the idea that the best sort of training for boys is that by which the qualities of a bull-dog, or of that sweet creature the Tasmanian devil, may be most thoroughly developed, should have died out long since. It belongs to the days when we were savages, when, perhaps, had we not been savages, we should have been wiped out of existence—the good old times of the Tudors which the modern survivals of savagery, the Jingoes and top-boot Tories, regard as England's best days. It will be held in future ages as a perfect marvel of idiotic conservatism that England should have retained to the last quarter of the nineteenth century a school-system fit only for the rearing of buccaneers and horse-thieves.

The vital defect of our school system is that it leaves the weakest to go to the wall. Every boy who passes through the course of training involved in the system must be for a time among the victims of this injustice; and nearly every such boy has to pass through the yet severer ordeal of being for a while possessed of power over fresh victims of this stupid and brutal system. "Is there any man living," says one who has passed through both parts of the school discipline, "is there any man living who has ever been to a public school, who can place his hand on his heart and say that at one time or another his school life was not *a hell upon earth?*" Strong words, but not one whit too strong. Every form of fiendish cruelty is practised by school bullies on their wretched victims. Not only so, but evil is developed by example, and even by precept, while good is discouraged. The boys of best disposition among the elders are for the most part silent, partly because they are outnumbered, and partly because in all communities evil is always louder and more prominent than good. A boy must be far above the average to escape the evil influence of bad example and brutal bullying while he is one of the weak: the chances are great that he will be himself a brutal bully, and in other ways set an evil example, when he has become one of the strong.

It may be urged that a large proportion of our best men have been brought up at public schools. Let it be granted. But even if all our worthiest had been so reared, that would prove nothing; for nearly all those who have any chance of high distinction must—for want of better—go to a public school. The argument is like that absurd reasoning in favour of studying two dead languages by way of preparation for life's struggle, that many of England's greatest men have been well versed in classical lore, and could, perhaps, still turn a police-court trial into Greek Iambics when already high in the service of their country. How could such men help being well ahead, as boys, in the only subject given them to work at? If chess and whist had been the chief subjects of their school work, they would have been well ahead in gambits and the conduct of trumps. Our great men who have come out from public school life undefiled and unbrutalised have done so despite the inherent savagery of the public school system: their greatness has owed about as much to their school training as the colour of their hair. If any one of our statesmen who have been at public schools could lay his hand on his heart and say, "It was when I was kicked daily, or welted with a stump every cricket afternoon

that my powers as a statesman were first unconsciously developed in me," or perhaps, contrariwise, "It was when I used to welt young Brown and Jones, holding them in slave-like obedience to my supreme will, that I first learned to control the fortunes of men and nations," then, indeed, we might form a different opinion (of him, if not of the school system). But no one acquainted with the real facts can for a moment doubt that our leading men have become great despite, and not because of, their public-school training.

But there is another aspect in which such brutalities as have recently been heard of may be viewed. It is singular how inapt many are to perceive the true meaning of boyish wickedness as developed at some schools. They talk of the misfortune that so many bad boys, cruel blackguardly louts, and so forth, should by chance have gone to such and such a school; and compare with the bad fortune of one school in this respect the good fortune of another, where the tone is so much braver and purer. Few seem to recognise the fact that a boy's nature is singularly plastic—in ninety-nine cases out of a hundred. It yields to surrounding influences—as the growing tree to the action of causes which when grown would produce little effect upon it. Where the boys of a school are bad, it is nearly always—nay, for my own part, I say "always" —because the influences to which they are exposed are evil; where the tone among the boys of a school is good, one may be well assured that they are under the influence of good men.

Oddly enough, I predicted, now nearly two years ago, the development of evil qualities at the very place where an unfortunate lad has been done to death. In an article on "Our Boys at School," which appeared in KNOWLEDGE for August 21, 1883, I called the attention of parents to the necessity of inquiring carefully whether the masters of schools where their boys were to go, had the qualities essential for the development of good feeling among the lads under their control. I named no names, but I was moved to write the article by the necessity which had, in my opinion, arisen for removing three boys of my own from King's College School. I recognised, in what my lads told me, clear evidence that the tone among the boys at the school was bad; and I knew that this can only be interpreted in one way. "If," I said, a parent finds, when talking the matter over with his boys, that "there are many 'mean fellows' among the boys, fellows who let others be punished for *their* offences, who cringe when they are not bullying, and bully when they are not cringing, be sure there is something wrong among the masters." Such evidence is far better than actual complaints of unfairness on the masters' part, for boys, like men, may complain without cause. But among a given number of boys there will always be a large proportion whose characters take their tone from the character of the masters; they will be among the good fellows if the masters help them that way; but they will sink into the ranks of the bad fellows (sneaks, bullies, and cowards) if the masters are of that kind.

I have in my thoughts two marked examples, each double in its significance, of the influence of good and bad masters, and especially of good and bad head-masters. In one case the tone in a school had been decidedly bad, many of the boys being bullies and cowards, selfish and treacherous. A new master (whom I have the pleasure of knowing well personally) replaced the master under whom the school had had this unpleasant character. Shortly after my own boys went to that school. They talk to this day with enthusiasm of the splendid tone prevailing there. The lads were neither bullies nor cowards, neither brutes nor sneaks—simply because the few boys who were really bad (some such there are in every gathering of boys) had their badness shamed out of them. The discipline was strict but just. Every boy knew what he had to expect, and was never disappointed, either in the way of reward or of punishment. At another school, of which I knew something, an excellent tone prevailed ten or twelve years ago. A change of masters came about, and now among the boys of that school brutality and meanness, vice and profanity (yet it is a professedly religious school, where all things are to be conducted *sancte et sapienter*) are rampant. The moral of this evidence should be obvious. The lesson it teaches is of vital importance—socially, morally, and nationally.—*Newcastle Daily Chronicle.*

MYSTERIES AND MORALITIES.

BY EDWARD CLODD.

I.

THE Revised Version of the Scriptures, now completed by the issue of the Old Testament, which seems somewhat in danger of being nicknamed the Caper-berry Bible,* is a recognition of the possible imperfections of the translations that have preceded it, as also of the uncertainty of meaning of the most ancient texts, the oldest of which are relatively modern, on comparison of which the *textus receptus* is based. The work of the revisers is, therefore, a distinct move in the direction of that more intelligent treatment of these venerable writings which will do more than theories concerning their divine authority to secure their abiding-place among the priceless records of human experience and spiritual development.

The revisers, who are presumably not influenced by commercial motives in their work, would have better shown their sense of its importance by issuing the complete version at such a price—say a few pence per copy—as would place it within the reach of the poorest, and, as the New Testament section appears to be a drug with the booksellers, the wisdom of cheap editions justifies itself.

Coincident with this publication is a re-issue of the celebrated *Biblia Pauperum*, or Bible of the Poor. This is a collection of pictures illustrating the story of man's redemption, accompanied by verses from the Scriptures in Latin, and, together with the "Mirror of Human Salvation" (*Speculum Humanæ Salvationis*) was the chief text-book used by the preaching monks. It was compiled in the thirteenth century, and printed in the fifteenth century, being probably the first book in which blocks were used, and it was followed, a few years later, by the printing and secret conveyance into England of Tyndale's New Testament, in fulfilment of that noble martyr's vow that "if God would spare his life, ere many years he would cause the boy who driveth the plough to know more of the Scriptures than did all the priests."

The completion of the Revised Version, and the republication of the *Biblia Pauperum*, suggests some account of methods employed both here and on the Continent, when the Bible was an unknown or prohibited book, for bringing home to the people the central facts of which it is the vehicle—an account the interest of which is greater for the student of human progress than for the antiquarian.

For many centuries such knowledge of the events nar-

* *Vide Times*, June 12th.

rated in the Bible as the unlettered laity possessed was diffused orally by means of paraphrases in local dialects and alliterative metre. The first native poem having these events for its subject was the work of Cædmon, a cowherd of the monastery of Whitby, concerning whom the tradition is that when sleeping in the stable-loft One came who said, "Sing, Cædmon, some song to me." Suddenly poetic inspiration seized him, and he poured forth verses which, on awaking, he recited to his fellow-servants. The Abbess Hilda was told this, and promoted Cædmon from the cowshed to the cloister, where he spent his days in making many poems "of the terrors of judgment to come, and of the horrors of hell-pangs, and of the sweetness of the heavenly kingdom," till his death in 680 A.D.

The paraphrases to which his work gave impetus were largely interspersed with quaint and absurd stories and legends, which, however, added to the dramatic element in them, and gave occasion for a certain degree of action on the part of the reciters. These found a willing audience among the retainers in castle-halls before whom the wandering minstrel had sung his ballad, and among the peasants on the village common before whom the strolling mountebanks had performed their tricks and pantomimes. They smoothed the way for that more elaborate presentment of the historical parts of the Old and New Testaments, and of incidents in the lives of the saints, which were the subjects of the early Christian drama and of the Mysteries and Moralities of the Middle Ages.

Miracle Plays is the name commonly given to this drama, but, speaking accurately, the Miracle Play is concerned with some event in the career of martyrs and confessors, while the Mystery, which is later in date, deals with Bible narrative only, the most frequent subject being the redemption of mankind as the central fact around which all the others gather.

In most dictionaries our word *mystery* is erroneously derived through the French from the Latin *mysterium*, as treating of the "mysteries" of the Christian faith, whereas it is the French *mystère*, originally written *mistère*, and derived from *ministère*, because the clergy, the *ministerium* or *ministri ecclesiæ*, were the first actors of religious plays.

The Morality was a didactic allegory, in which virtue and vice, passion and feeling, were personified by the actors; but although it arose independently of, and long remained distinct from, the Mystery, a fusion between them occurred later on, the allegorical figures alternating with historical characters. The plays were originally performed within abbey walls, and viewing the attitude of antagonism which the Church had for ages manifested towards the drama—an attitude justified by the degrading influences of which it had become a too willing agent in its decadence under the Empire—it is at first glance matter for surprise that its revival occurred under her ægis. But the abolition of the theatre did not destroy the passion innate in man for dramatic presentment of life's affairs, or the love and need of some sort of recreation, and this had long found satisfaction in rude and rough amusements which fostered neither morality nor gentleness. In England there was no lack of religious and national festivals. So numerous were they, that in the reign of Henry VIII. the Commons petitioned for their reduction, the more so that they were made occasion for "execrable vices" and "idle and wanton sports." Not only did the restraints upon the clerics and the nuns cause a reaction which expressed itself in travesties of services and rites in the sacred buildings, but the feasts and holy days of the pagan faiths which Christianity had displaced, and which were older than any organised religions, survived with new associations, with new names, and under grotesque and often licentious forms. They typified the character of the rougher races of the North, and flourished with the connivance of a clergy itself not too pure in life. With that profound insight into human nature which has rarely deserted her, with that unerring touch of the material with which she has to deal, which has been a truer inspiration than the higher guidance she has claimed, the Church was moved to gradually utilise for loftier purposes that which had been put to base uses. Whilst tightening her hold she extended her usefulness by recognising in the drama (into whose mould the pre-Christian beliefs were poured, the pagan mysteries being essentially dramatic), a powerful and pliable instrument for relieving the monotony of the monastic and conventual life, and for instructing the unlearned in the history and doctrines which she claimed sole divine authority to teach. In later days, with the supercession of the religious and ethical by the purely secular drama, she disowned and maltreated her foster-offspring, refusing to the players her consoling rites, and denying them burial in consecrated soil; but no desertion of hers can destroy the fact that she was the nursing-mother of Shakspere, Molière, and Goethe, and that the first revival of the theatre is to be found in the religious plays.

Traces occur as far back as the second century of plays the incidents in which are founded on the Bible, and the framework of which is modelled on classic lines,* as in the Passion of Jesus (*Christos Paschôn*), which is after the manner of Euripides, the old choruses being represented by Christian hymns, and as in some plays by Hroswitha, a Benedictine nun of the tenth century, who dramatized legends of the saints on the model of the comedies of Terence. It is probable that her dramas were performed at Gandersheim, within the nunnery, as aids to the instruction of the children under the care of the religious foundations. Three plays by Hilarius, an English monk of the twelfth century, have for their several subjects the raising of Lazarus, the story of Daniel, and a miracle wrought by St. Nicholas, of whom tradition records that even while he was an infant he conformed so rigidly to ecclesiastical rule, that he fasted from the breast on Wednesdays and Fridays!

The earliest recorded performance of a miracle-play is of the play of St. Katherine (*Ludus de S. Katherina*) at Dunstable, in 1119, when the actors borrowed their dresses from the abbey of St. Alban's. This play is referred to by Matthew Paris, a writer in the following century, as of the kind "*quem miracula vulgariter appellamus.*" Performed privately at first, as remarked above, within monastery walls for the recreation of the featureless lives of the inmates, the plays were extended to the church, with the clergy and choristers as actors, and gradually became more popular in form and less restricted in their audiences as their wholesome influence grew more apparent. Originally written in Latin, they were rendered into Norman-French to adapt them for exhibition before the Court, and then into the vernacular† for

* The first drama known to have been written on a Scripture subject is a Jewish play, of which fragments are extant in Greek Iambics. It is taken from the Exodus, and the leading characters are Moses, Sapphora, and God in the burning bush.

† In the Brit. Mus. MS. of the Chester Plays, it is related that the author "was thrice at Rome before he could obtain leave of the Pope to have them in the English tongue."

the entertainment and edification of the people,* the clerical character of the actors being shown by the retention of the stage directions in Latin. In 1210, Innocent III. sanctioned their performance outside the churches, before the door or in the churchyard, or in other open places, on fixed or movable stages; and a further step towards secularization was made when the control of the plays passed into lay hands, from the clergy to the trade guilds, by whom they were acted in the chief thoroughfares of the large towns.

These innovations were due not merely to the increasing importance of the miracle plays as sources of instruction, but also to the growing demand of the townspeople for diversion as material progress left a larger margin of leisure. And it is interesting to note that the passage of the plays from beyond the church nave is connected with the growth of another institution of unsuspected ecclesiastical origin—the national fair—which had its rise in supplying the needs of pilgrims gathered round abbey walls and shrines to honour the festival of the patron saint whose relics lay beneath the altar.

As late as the reign of Henry VII. half England was fen and forest. Through the dense masses of the one wandered the roe and the red deer, and the silence of the immense breadths of the other was broken only by the cry of wild birds, the bustard, and the swan, and by the ringing of the vesper bell from the monastery rising like a beacon across the wastes.

The richest lands, mostly pasture, were in the hands of the monks, who swarmed in thousands like locusts over the country, whilst round them was a peasant class, often reduced by severe fluctuations in harvests to eat bread made of peas, vetches, and fern roots. Moreover, the centres of supply were too scattered, and the garners of the abbeys too limited, to feed the hungry crowd that, attracted by their holy relics, encamped in or about the grounds in tents which survive amongst us in the booths of country fairs. With these were the stalls of the dealers and the bazaars of the travelling merchants, who took advantage of the concourse for bargaining their wares, and for purposes of general trading. The fair was named after the saint whose *festa* brought the pilgrims together, and which was utilised by the clergy for acting the Miracle Play, or some series of events from scripture history in the Mystery. "Thus in the time of Constantine, Jews, Gentiles, and Christians assembled in great numbers to perform their several rites about a tree reported to be the oak Mambre, under which Abraham received the angels; at the same place," adds Zosimus, "there also came together many traders, both for sale and purchase of their wares."† In the larger towns, the trade guilds had each their patron saint, and the day dedicated to him became the occasion for pageants, in which a miracle play was performed, first in the hall of the guild, and then in the thoroughfares. The stage appointments became more elaborate, the characters of the plays underwent extensive alteration, tragedy was relieved by comedy, the sacred story enlivened with jest and tinged with local colouring, and the way gradually opened for the ultimate release of the drama from ecclesiastical swaddling-clothes, and the bestowal upon it of that independent life which grew into such vigour and splendour in the England of Elizabeth.

* There is a MS. of the sixteenth century extant in the Bodleian Library of three miracle-plays written in the old Cymric of Cornwall, the subjects of which are "The Origin of the World," "The Passion of our Lord," and "The Resurrection of our Lord"; and Carew, in his "Survey of Cornwall" (1602), describes the earthern amphitheatres built by the Cornishmen for the performance of miracle-plays. Cf. "Morley's Eng. Writers," vol. I., 718.

† Morley's "Bartholomew Fair," p. 16.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

COLEOPTERA (*continued*).

THE beetles whose ravages and life history have already occupied our attention illustrate very well two of the great primary divisions of the Coleoptera, viz., the Teredilia, or Wood-borers, containing the death-watch and its allies, which are all summed up in a single small family, and the Clavicornia, or Clubhorns, to which the bacon-beetle and its skin-devouring relatives are referable. We thus see that in each section, out of some hundreds of species of more or less similar structure, only a very small proportion, and those almost entirely confined to a single family in each case, bring themselves into collision with human household interests.

And in the same way, to get our next illustrations, we must go to another great primary section of the order, and select a few species therefrom. This section is called the Heteromera, a word which, being literally translated from the Greek, means "different joints," and is given in reference to a peculiarity by which these insects are sharply distinguished from most of those already referred to, viz., that while the tarsi, or feet, of the first two pairs of legs consist of five little joints succeeding one another in longitudinal row, those of the hind pair have only four such joints, our preceding examples, except the little oddity *Mycetæa*, having been furnished with five on all their limbs.

The Heteromera are a remarkable set of insects, more fully represented in tropical countries than in our own islands. We possess less than 120 species, and these do not all rightfully belong to us; but even this small number includes insects of such diverse habits and structure as to necessitate their subdivision into nearly sixty genera. The economy of some, too—such as the familiar oil-beetle—is more wonderful than that of any other Coleoptera whatever.

Fig. 1. Blaps mucronata. A, side view of elytra.

Our first example from this group is the insect known to science as *Blaps mucronata* (Fig. 1), and popularly called the "churchyard beetle" and "cellar beetle." It is utterly unlike any other British insect except the other two members of its own genus, and these it resembles so closely as to be with difficulty distinguishable from them. It is a dull-black creature, nearly an inch in length, with long straggling legs, and without wings, though the wing-covers, or elytra, are even more

largely developed than usual. These cannot, however, be opened, and are, indeed, actually fastened together—"soldered" is the technical term—along their central line of junction, thus forming a flattened arch over the body.

It shows no trace of ornamentation on any part of its body, not even the customary longitudinal furrows and rows of punctures so characteristic of beetles, and at first sight the integument seems to be perfectly smooth; examination with a lens, however, reveals a minute and indistinct, irregularly-scattered punctuation. The body is broadest a little behind the middle, and at the tail, the elytra, instead of terminating in a smooth, evenly-rounded edge, are each produced, at the tip, into a blunt projection curled upwards. The name *mucronata*, from the Latin *mucro*, a spear-point, refers to this odd little tail, which is, nevertheless, not confined to this species, but is represented in one form or other throughout the genus. Turning next to the organs of sense, we find another striking peculiarity in the eyes. Instead of forming projecting rounded masses, as is usually the case, they consist of two long, narrow, almost kidney-shaped strips, just behind the antennæ, and not raised above the general surface; this want of prominence of the visual organs finds its explanation in the darkling habits of the creature. Finally, the last four joints of the antennæ are like round black beads.

Blaps has really very little to recommend it. Its dull, sombre aspect is the reverse of attractive, and agrees well with the retirement and obscurity of its life. Clad so completely in the deepest of mourning, it could not be let alone by superstition, and has therefore been regarded with terror as an ally of the powers of darkness, and an associate of death—a creature whose natural abode could be none other than a charnel-house. Ideas so fostered found apparent support in the repulsive odour it continually emits, resembling that of putrid flesh, and in its not unfrequent occurrence in churchyards. Its disgusting odour is produced by the vaporisation of a fluid found in two oblong vesicles near the tail.

An unusual length of legs is generally an indication of agility, but not so with *Blaps*, which is a very tortoise in speed. It leisurely lifts one leg after the other, cautiously bringing them again to the ground, as though its vitality were well-nigh exhausted, and these were its last feeble efforts before giving up the ghost. Nothing could be farther from the truth, however, for its stock of vitality is extraordinary, and enables it to survive dangers and difficulties which would speedily be fatal to less hardy creatures. About a century and a half ago, when entomology was hardly yet a science, and the means of destruction of insect life not so varied or efficacious as at present, a struggle, so celebrated as to have been thought worthy of permanent record in the transactions of the Royal Society, took place between a *Blaps* and an entomologist; the latter made no less than four different attempts at the execution of the former, by immersing it in spirits of wine for periods of increasing length, the last extending over some twelve hours. On each occasion life appeared to be extinct, but each time also, on being removed from the fluid, the apparent corpse became reanimated, and the victim of alcoholic excess entered on a new lease of life, till at last the sentence was remitted, and the insect lived with its captor unmolested for three years afterwards, and even then the record of its experiences was brought to a close, not by its own decease, but by the carelessness of a domestic, who allowed it to escape.

This insect is often found in cellars, stables, and out-houses, dark and damp spots being especially congenial to its tastes. It shuns the light of day, and is chiefly nocturnal in habits. Though so disgusting in smell, it found a place in the Materia Medica of the Romans, the case recommended by Pliny as an infallible remedy in treatment. ulcers which would yield to no milder

The larva is a long,

legs in front, very similar row creature, with six short which, indeed, it is not very distainary meal-worm, to a pale yellowish-white colour, and not hairy. It is of of the *Dermestidæ*. This, therefore, is the third type of larva we have met with; the first, of the *Ptinidæ*, plump, fleshy, soft, pale, and curved; the second, of the *Dermestidæ*, densely hairy, like moths' caterpillars, and the third, that of *Blaps*, long, narrow, and smooth. The larva of an allied species has been turned to account by the women of Egypt, who, following the precepts of "insectarianism," are said to make a savoury dish of the grub by roasting it and serving in butter, partaking of it with a view to the cultivation of *embonpoint*.

(To be continued.)

NOTES ON MAPPING.

By RICHARD A. PROCTOR.

CENTRAL PROJECTIONS.

AN EQUAL SURFACE PROJECTION.

THE conical projection which I have described in my papers on mapping is on the whole the best for representing small portions of the surface of a globe, and especially for maps of the constellations on the heavenly globe, and of countries of moderate size on the terrestrial globe. But when it is necessary to represent larger portions of a globe a central projection is nearly always to be preferred.

It is true that in all terrestrial atlases hitherto made, and in all celestial atlases except the Gnomonic Atlas of the S.D.U.K., and my own celestial atlases (Gnomonic and Equidistant, larger and smaller), other projections have been used. But this has been done to save trouble, and the result has been most unsatisfactory. Consider for instance the maps in a terrestrial atlas. We find Europe drawn on a nondescript projection in which the parallels of latitude are concentric circles, as in the conical projection, while the meridians are such curves as result from measuring off successive equal arcs along each of these concentric circles, the arcs being larger as the radius of the circle on which they are measured off is longer. Asia and North America are on similarly absurd projections, and being much larger are much more distorted, insomuch that at the upper corners of these maps the outlines are hardly recognisable. Africa and South America are on a projection in which the parallels are straight. Small countries are on the conical projection. The hemispheres are on a projection which has no definable character, except that it is rather easily drawn. Then we have the chart of the world on Mercator's Projection, which, however serviceable for navigation, is perhaps less suitable for geographical purposes than any projection yet invented.

This variety, and the resulting incongruity, render our atlases far less instructive and less truthful than they should be, and as they might easily be made. There is no reason why one and the same projection should not be used for all large sections of the earth's surface, as I

have shown to be possible for the surface of the celestial sphere. Somewhat more labour would, of course, be involved; but only in making the projections (once for all); and the result would amply repay the trouble.

I propose to give here some examples of central projections fulfilling various qualities, leaving to another occasion—possibly to future mathematical papers—the discussion of the geometrical principles on which these various methods depend.

I take first the equal surface projection which I have used so often in star-maps—as in my chart of 324,000 stars, my charts of the northern and southern heavens, and in other cases. The reason why I take this first is not that it naturally comes first, in the discussion of central projections; for I think the equidistant projection should come first, and the stereographic next. But in separate papers such as those I write here on mapping, a strict order need not be observed in such matters; and just now it has occurred to me that an equal-surface projection of the earth's surface would be interesting to English folk, much exercised as they have been by anxiety lest other nations should occupy too extended or too advantageous a position on the surface of our little world. I have before me as I write a large coloured chart on Mercator's Projection, from the *Illustrated London News;* and therein I see our British Empire (which has grown so largely and prospered so greatly under the influential sway of the gifted authoress of "Our Diary in the Highlands"), tinted red for comparison with the yellow-tinted empire over which the Emperor of all the Russias bears beneficent and fatherly sway. The chart is interesting;* but it is impossible to form

* Comparing it with the maps of the world which I drew as a boy, I note how far Russia has wickedly spread over Central Asia, and how near the boundaries of the Russian Empire and of British India have approached each other. The true-born Briton feels proud to think how Great Britain's daring has been in extending her dominion northwards and westwards in India so rapidly, notwith-

the least idea of the dimensions of the various empires of the world from a chart on Mercator's Projection. The Russian Empire is preposterously magnified, our Indian Empire (I beg ten thousand pardons, I should have said her Most Gracious Majesty's) as absurdly reduced. Greenland is larger, on such a projection, than Africa; British America very much larger than Australia, and other monstrous errors of area are presented.

The accompanying charts are on a central equal-surface projection. The projection is obtained (or *may* be obtained, for in practice the use of a table of natural sines is far more convenient) by the construction shown on next page.

Let the equal straight lines AOB, COD (Fig. 1) intersect at right angles in O, the bi-section of each; and let A O equal the diameter of the globe we wish to project. Divide each of the quadrants, A C, C B, into eighteen arcs of 5° each. Connect in pairs the division marks equi-distant from A and B, as shown in the figure, by lines cutting O C in *k*, *l*, *m*, *n*, &c. Then O K is the radius for the projection of the small circle 10° from O; O *l* is the radius for the small circle 20° from O; and so on. Thus if P and P′ are 35° from A and B, and P P′ cuts O C in N, the circle N *p* N′ about O as centre represents the circle on the globe 70° from O. Similarly M *q* M′ is

standing the well-known fact that as soon as the Russian Empire reaches India, our power in India is bound to collapse. If this daring advance towards the Russians has been accompanied by some rather perplexing, shivering fits at *their* advance towards us (which manifestly is a very different matter) we may perhaps explain this as due to the belief that that remarkable document known as Peter the Great's Will was, as it were, a divinely-inspired prophecy. For somehow the Germans and Austrians manage to live without anxiety-agues though bordering directly on the Russian Empire, and even the unspeakable Turk does not proclaim his terror of approaching dissolution so loudly as some in our British Parliament proclaimed their assurance that because Russia has appropriated a few hundreds of square miles a thousand miles away from our borders, our rule over India is doomed.

the circle representing a great circle (90° from O) on the sphere.

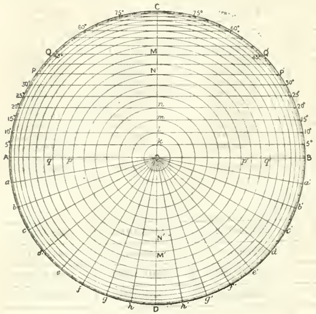


Fig. 1.

If the map is a polar map, then the circles thus obtained are parallels of latitude, 10° apart, and radial lines to the alternate divisions round A C B D, as in the lower half of Fig. 1, are the corresponding meridians.

The meridians and parallels for the illustrative charts have been obtained on this principle, only that instead of the geometrical construction just given, I simply took out the natural cosines of 5°, 10°, 15°, &c., to represent the radii of the parallels having polar distances 10°, 20°, 30°, &c. The whole globe can be represented, as we see from Fig. 1, in a single chart on this projection. In my "Essays on Astronomy" there is an article on equal-surface projection illustrated by charts of the whole surface of the earth on three projections possessing this property. The first of these charts is on the polar equal surface projection here considered. There are also projections of the whole globe in my little treatise on "Elementary Physical Geography." Of course the distortion in parts of such maps is necessarily very great.

In the illustrative charts the British Empire is tinted by meridianal shading, the United States by shading along latitude parallels, the Chinese Empire by slant lines in one direction, the Empire of Brazil by slant lines in another direction, and the Russian Empire is spotted. [By the way, when we consider that the British Empire is not much more than half-a-million square miles larger than the Russian, and note the limited shore-line we command, our anxieties about Russian encroachments in Central Asia seem more than justified. There is a bare possibility that Russia may one day extend across Persia or Afghanistan, *so as actually to reach the shores of the Indian Ocean!* What a terrible thing that would be for British commerce!]

PHOTOGRAPHY continues to increase in popularity. A new society just established in Birmingham starts with seventy members, and promises to be of real use to the town and district. The meetings are held in the Technical School, Bridge-street. Dr. Hill Norris is President; Mr. W. Jerome Harrison, F.G.S., vice-president; and Mr. Joyner, of 43, Bull-street, hon. secretary. At the first excursion —to Salford Priors, on June 27—nineteen members were present, and seventy-three plates were exposed.

STATISTICS OF GREAT COUNTRIES.

By RICHARD A. PROCTOR.

THE table on the opposite page, compiled from Whitaker's Almanac (a perfect marvel of collected information) will be found interesting in connection with the preceding article and the equal surface charts of the globe. I have there arranged in order of area the principal countries of the world. (The Argentine Republic is included on account of its great extent, having manifestly no other claim to be regarded as a great country.)

I may add the following statement respecting the British Empire and the United States together. (The mere accident that those Britons who established certain British colonies in America, eventually elected to be independent of the mother country does not render the United States less thoroughly a British product—nay, that very independence was a product of British energy, though Germans and other foreigners who arrived after the work was done, may take pleasure in regarding themselves as natives and English folk as foreigners in the United States):—

	Area in square miles.	Population.	Exports and Imports.
English-speaking nations and possessions.	12,491,726.	367,225,000.	£1,371,842,260.

But as regards exports and imports, the United States, by a foolish protective system (in political economy America is still a mere child among the nations) has spoiled the splendid total which the English-speaking nations might otherwise have shown. Imagine fifty millions of the most commercial people in existence, with a magnificent country and a splendid seaboard, free also from the necessity of maintaining large forces for defensive purposes (to say nothing of their prudent avoidance of aggressive courses), yet with little more than one-third the imports and exports of our 36,300,000 in the old country! And they claim to be a progressive, nay a go-ahead nation!—regarding us as effete. (If we are, though, things look bad for our kinsfolk over the water, who presumably have inherited our national qualities.)

The wiseacres who regulate American commerce (and are regarded by many Americans as statesmen!) conceive that the way to make a nation rich and prosperous, is to force it to manufacture at great cost (and pretty badly, too, in many cases) what they could get more cheaply, and much better, from other nations. They neglect altogether the splendid opportunities which America would have if she drove—as she could—a roaring trade with other nations in the multitudinous articles which her people can manufacture well, and (owing to natural advantages) at less cost than other countries. They imagine the artificial rise of wages to meet the enormous extra cost for necessaries of many sorts, a real gain; not seeing that labour would be far more profitably remunerated, and have a much more rapid (because a more natural) growth if directed to such manufactures as would make of America a great exporting nation. And because the old country (which has long since come to years of discretion and has learned that as among individuals so among nations, the loss of one is a loss for all and the gain of one the gain of all) would be glad to see wiser counsels prevail, America fondly imagines that Britain would be the only gainer if America threw away

	Area in Square Miles.	Population.	Revenue.	Public Debt.	Imports and Exports.
BRITISH EMPIRE :—			£	£	£
Great Britain and Ireland...	121,115	36,300,000	87,205,000	746,400,000	732,228,000
Indian Possessions	1,558,254	258,000,000	80,000,000	160,000,000	131,072,000
Other Eastern Possessions...	30,000	3,900,000	3,000,000	2,800,000	40,500,000
Australasian......................	3,181,344	3,100,000	22,000,000	100,000,000	114,500,000
North American	3,620,500	4,650,000	7,185,000	41,000,000	35,000,000
In Guiana	100,000	200,000	500,000	500,000	4,000,000
African..............................	270,000	2,350,000	5,805,000	18,275,000	19,000,000
In West Indies, &c.	12,707	1,350,000	1,550,000	2,000,000	9,900,000
European Possessions.........	120	175,000	255,000	380,000	2,000,000
Various Settlements	96,171	200,000	500,000	250,000	2,000,000
Total	8,990,211	310,225,000	208,000,000	1,071,605,000	1,090,200,000
RUSSIAN EMPIRE :—					
European	2,074,686	84,851,886	—	—	—
Asiatic	6,250,707	15,186,456	—	—	—
Total	8,325,393	100,038,342	124,563,002	416,500,004	258,371,918
CHINESE EMPIRE..............	4,540,000	250,000,000 ?	Unknown.	Unknown.	43,000,000
UNITED STATES	3,501,515	57,000,000	70,000,000	280,000,000	281,642,260
EMPIRE OF BRAZIL............	3,288,000	10,200,000	13,304,940	86,316,880	Unknown.
TURKISH EMPIRE :—					
European	130,571*	8,971,000*	—	—	—
Asiatic	729,981	17,536,465 ? ?	—	—	—
African (nominal sovereignty), including :—					
Egypt	212,600	5,517,000	—	—	—
Tripoli	344,400	1,200,000 ?	—	—	—
Tunis.........................	45,716	1,500,000 ?	—	—	—
Total	1,463,268	34,724,465	14,500,000	107,500,000	Unknown.
ARGENTINE REPUBLIC	1,357,896	2,540,000	6,247,330	26,934,500	5,849,790
FRANCE :—					
European	204,096	37,672,048	—	—	—
African Possessions	300,000	3,250,000	—	—	—
Total	504,096	40,922,048	132,673,709	942,000,000	356,142,680
AUSTRO-HUNGARIAN EMPIRE	240,940	38,000,000	76,680,034	452,428,217	Abt. 62,000,000
GERMAN EMPIRE	210,161	45,234,061	29,540,967	18,947,358	331,200,000
ITALY	114,408	28,459,451	62,519,002	Abt. 100,000,000	101,164,671

* Including Bulgaria, Eastern Roumelia, and Bosnia.

the weakening bandages of the so-called protective system. America has now for many years been engaged in diligently biting off her nose to spite her face.

WATCH-MAKING AT THE INVENTIONS EXHIBITION.

(*Continued from p. 523.*)

IN the dial-making room are performed the various operations necessary to the production of dials. The dial consists of a sheet of copper, which, in a single operation, is cut and pressed to shape, and pierced for the passage of the hand centres at the necessary places. After this, the dial feet are brazed on. These feet, which attach the dial to the watch movement, may be seen under manufacture at the Exhibition. Lengths of copper wire are put into the machine, which automatically cuts them to the required size and cleans off the ends of each piece. A vitreous or glassy solution is applied to both sides of the dial, which is then fused on in suitable gas furnaces (Fig. 9). The next step is to paint on the hours, which is done by hand with a camel's hair brush. When these figures are finished and the surplus paint scraped off, the company's name and then the minutes are painted on. The paint used for these purposes is also of a vitreous nature, whence each dial has to be again placed in a furnace to fix the enamel letters.

In the Gilding Room (Fig. 10) electricity is, perforce, largely employed in the various processes involved. All brass movements, after receiving what jewelling they may require, are immersed in a nitric, sulphuric, or hydrochloric acid bath for cleansing purposes. Any particles of foreign matter not removed by the bathing

yield to the influence of revolving wire-brushes, to which the parts are subjected prior to their immersion in the gilding solution.

The electricity necessary for the gilding is derived, in some cases, from the well-known Daniell battery, and in other from dynamo-electric machines. There is little doubt that the great amount of attention recently bestowed on dynamos for the purpose of electro-deposition will speedily result in the exclusive use of those machines in places where a considerable and steady flow of work has to be got through. It is stated that the works of every thousand watches absorb in the gilding processes eight to ten pounds' worth of the precious metal. As our readers are doubtless aware, the gilding solution is of a highly poisonous nature, and the fumes or vapours arising therefrom are none of the healthiest. To get rid of these, an exhaust-fan is provided to free the room of such impurities.

Fig. 11 illustrates the case-making department. Only silver cases, however, are made at the Waltham factory, the gold ones being manufactured in the New York establishment. The silver bars are rolled down into sheets and then cut and pressed to shape—the parts being subsequently fitted together in the turning-room. The jointing and soldering is then done. The cases are next milled through for the joints, and the caps put on. In the opening-room the winding crown is put on, and the joints fixed so that the case will open at right angles. It next goes to the springing-room to receive the lifting spring and catch spring. The parts are then separated for polishing, and the backs sent to the engraver and engine-turner. It is next matched up again, and the pins put in, and finally polished; after which it is backed and glassed ready for delivery. There are 150 operations needed to manufacture an ordinary watch-case. The department produces 700 silver cases a day, employing 400 hands. The stock on hand comprises £18,000 worth of silver, and about £2,000 in gold for joints, &c., to guard which three large vaults have been constructed. The washings of aprons and hands, and the sweepings of the floors, and the cast-off garments of the workmen, are all saved up to be reclaimed in the refining-room; and thus a large amount of metal is saved.

This closes our remarks on the sections of the factory. Suffice it to say, in conclusion, that, since the Paris Exhibition of 1878, the cost of producing a watch movement has been reduced to about one-half of what it then was, and that consequently the trade, both for home use and for export, is rising rapidly. The introduction of machinery is so extensive that the manager can undertake to draw the raw materials from stock in the morning, and have a watch made from them at noon, every part of the work being done on the establishment, with the solitary exception of making the mainspring, which is of French production.

As evidence of the rapid strides into public favour of Waltham watches in recent times, it may be stated it took the company twenty-three years to make the first million watches, six years to make the second million, and the third million has been made in two years, while at present so great is the demand for them that the company is preparing machinery to produce 2,000 watches per day. The Waltham Watch Company's tools and machines are one of the chief centres of attraction at the Inventions Exhibition, and are daily visited by eager throngs, among whom may be noted the leading scientific men and mechanicians of the day, who invariably admire the celerity, wonderful ingenuity, and marvellous accuracy of these lifelike automatic machines.

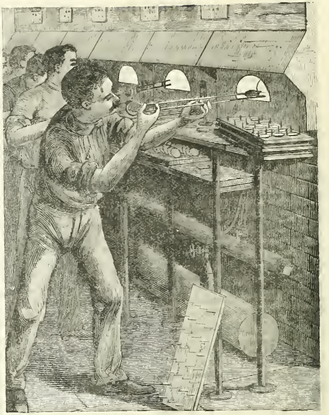


Fig 9.

Fig. 10.

Fig. 11.

Gossip.

By Richard A. Proctor.

I see that some Fellows of the Royal Astronomical Society have been complaining—for the fiftieth time—that the *Monthly Notices* only come out a month after the meeting when they were read. In reply to the remark that when I conducted the notices the papers came out a fortnight earlier, those responsible for the gross dilatoriness complained of, answered that it was better to bring the papers out free from errors than in good time. To the implied idea that there were more errors in the papers in my time than now, I reply that the insinuation is untrue. The proportion of errata to the quantity of matter was if anything less in my time; but the quantity of matter was much greater. To the question, how I managed to get out the *Notices* in good time, I answer that if I had not managed to do so I would not have accepted the fifteen pounds paid quarterly for the work. As a matter of fact, I did work worth *to me* about six times the stipend for which I consented, as a favour to the Council, to hold the office while Professor Cayley was President.

Being very far from England at present (but in a few weeks now I shall be in the old country again) I see with some dismay such statements as "Hallyards" makes respecting me, in Knowledge for May 29 (let. 1723, p. 465); for by the time my correction arrives the idea will have been wholly absorbed by many readers that the views he has attributed to me are really mine, and correction is apt to avail little after that. "The Conductor of Knowledge has remarked somewhere," he says, "that it is rash to suppose all bodies to be moving in curves, that probably many stars move in straight lines." Where and when have I ever said anything so absurd? I know of no time since I was ten or twelve years old, when I have not known better,—always excepting my sleeping hours, during which I may, for aught I know or can remember, have dreamed of stars moving in straight lines, just as I have dreamed of dead folk talking to me, and the like. A little further on "Hallyards" says that he thinks "the Conductor of Knowledge has remarked somewhere that space *cannot* be infinite." I have said that we cannot imagine space *otherwise* than infinite, most assuredly not what "Hallyards" attributes to me. The nearest approach to it has been my remark that we cannot *conceive* infinite space, — a mightily different matter. (I cannot conceive how "Hallyards" has misapprehended me so strangely; but the fact that he *has* done so is patent.)

Having imagined me to have invented stars moving in straight lines "Hallyards" gets up a sort of discussion, between this semi-idiotic second self he has made for me, and his own self. "I do not see," he says, "how this can be if there is even the very least pull on one of them from the nearest larger body: if gravitation be indeed true for all distances, then I do not see how any body can avoid an orbit." Neither do I, but my second self is made to argue very foolishly that a body *can* avoid an orbit. "It will be replied," "Hallyards" remarks, "that their rate of translation will overcome the pull of the nearest body,"—though any one who would reply thus would say anything. "But there again," he proceeds, "seems" ("seems, nay is, I know no seems") "another exception to the universality—or at least, the autocracy—of gravitation." All this is naught.

It is a misfortune that few men of science will condescend to avoid the use of technical terms, while scarcely any seem able, even if they were willing, to write intelligibly even when they use ordinary words. But it is a worse fault still that many writers about scientific matters seem to consider the constant use of metaphors essential to effect. It would almost seem that they imagine the facts of science to be without interest unless presented in fanciful form.

Here for instance is a passage from an article in the *Times* for May 27, in which the application of photography to science is considered. (The article, by the way, presents, as very striking and novel in the middle of 1885, rather less than I described as accomplished facts in the second number of *Longman's Magazine*, two years and a half ago.):—

"Every fresh step in optical mechanics has multiplied the working capital of philosophy" (imagine the multiplication of capital by walking!). "A refractor like that at Washington widens at a bound the reach of astronomical generalisations." (Imagine, yet again, something which widens the reach of some other things by bounding!). "It resembles for the eyes an extension of a range of several miles for a gun." (An extension in what degree? for a range of several miles may be extended by a yard or by half a mile.) "The weakness of the telescope is that, as the eyes are quickened and sharpened by it, so it is chained by and to the eyes." (The eyes are quickened and sharpened, it would seem, by something—whether the telescope or the telescope's weakness, is not clear—which is chained by them and to them! Surely as a metaphor this surpasses the rat which Castlereagh "smelt," and saw "floating in the air," but promised presently to "nip in the bud.") "Chemistry puts forth its prepared gelatine and bids it concentrate itself on hoarding each thin ray which strikes it, as children's pence in a school bank." (Angels and ministers of grace defend us! What may this mean? Do the thin rays strike chemistry like children's pence in a school bank? or do they strike gelatine after that strange fashion? Then, what is a thin ray? And why should a thin ray be more aggressive than a fat one? or be hoarded more carefully?)

The Darwin Medal for 1884-5—founded by the Midland Union of Natural History Societies—has been awarded to our contributor, Mr. W. Jerome Harrison, F.G.S., for his geological researches.

Messrs. Kegan Paul, Trench, & Co. will publish immediately a new and much cheaper edition of Mr. Francis George Heath's "Autumnal Leaves."

London by Night.—Into the grim world of "London by Night," Mr. Thomas Archer has recently made a fresh tour of discovery, and has recorded his impressions in an article which is to appear in *Cassell's Magazine* for July, with illustrations from a well-known pencil.

The Earth's Annual Meteoric Growth.—It is calculated by Dr. Kleiber, of St. Petersburg, that 4,950 lb. of meteoric dust fall on the earth every hour—that is, 59 tons a day, and more than 11,435 tons a year. I believe this to be considerably short of the truth. It sounds like a large annual growth, and the downfall of such an enormous mass of meteoric matter seems suggestive of some degree of danger. But in reality Dr. Kleiber's estimate gives only about twenty-five millions of pounds annually, which is less than two ounces annually to each square mile of the earth's surface. —R. A. Proctor, in *Newcastle Weekly Chronicle*.

THE FACE OF THE SKY.

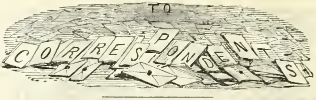
FROM JULY 3 TO JULY 17.

BY "F.R.AS."

THE recent indications of renewed solar activity in the shape of grand spots render the sun a very interesting object whenever the sky is clear. The face of the night sky will be found depicted in Map VII. of "The Stars in their Seasons." Twilight persists all night long during the fortnight which these notes cover. Mercury is an evening star, and, towards the end of the next fourteen days, may quite possibly be picked up with the naked eye over the W.N.W. horizon after sunset. Venus is an evening star, too, and may certainly be seen in the same part of the sky. She is still a very insignificant and uninteresting object in the telescope. Jupiter may be caught pretty close to the horizon after dusk; but at this time he is too low down for telescopic examination. The only phenomena of his Satellites theoretically visible are the reappearance of Satellite IV. from eclipse at 8h. 28m. 40s. on the 3rd; the egress of the shadow of Satellite III. at 8h. 27m., and the occultation of Satellite II. at 8h. 50m. on the 13th; the occultation of Satellite I. at 9h. 38m. on the 14th; and the egress of the same satellite at 9h. 15m. the next night. The observation of any of these is, however, doubtful. Mars and Saturn are invisible, as is Neptune too; but Uranus may possibly be seen under unfavourable conditions as soon as it is sufficiently dark. The Moon enters her last quarter 25·6 minutes after noon on July 5, and will be New at 5h. 15·8m a.m. on the 12th. High tides may be expected about this date. No occultations of fixed stars will take place during the time which our notes cover, save one of Aldebaran in bright sunlight at 11h. 23m. 26s. a.m. on July 9. When they begin, the Moon is in Pisces, across which she is travelling until 4 p.m. on the 6th, when she enters the N.W. corner of Cetus, quitting it, however, for Aries at 2 o'clock the next morning (that of the 7th). At 6h. 30m. a.m. on the 8th, she crosses the boundary between Aries and Taurus. Her journey through Taurus occupies her until 4h. 30m. p.m. on the 10th, at which hour she passes into the narrow northern strip of Orion. By three o'clock the next day, she has crossed this and emerged in Gemini. At 2h. 30m. p.m. on the 12th, she leaves Gemini for Cancer, and Cancer for Leo in turn at I a.m. on the 14th. She is travelling through Leo until 8 a.m. on the 15th, when she descends into Sextans, to re-emerge in Leo at one o'clock the same afternoon. She finally leaves Leo for Virgo at I p.m. on the 16th, and is, of course, still in the last-named constellation when these notes terminate.

THE members of the Society of Telegraph Engineers, at the invitation of their president, Mr. Spagnoletti, Telegraph Superintendent of the Great Western Railway, paid a visit to the Swindon Works on Tuesday. Some five hundred members went down by special train, and the visitors spent a most interesting and instructive day. The works, as may be imagined, are of colossal proportions; they cover an area of thirty acres, and give employment to upwards of 5,000 men. No effort was spared, on the part of the railway officials, to make the trip pleasant and profitable to all who took part in it. The possible output is at the rate of one engine, six carriages, and fifty trucks per week.

WE give the following from a paper entitled "On a variation in the size of an image on the retina according to the distance of the background on which it is seen," by Alfred Brothers, F.R.A.S., which was read before the Manchester Literary and Philosophical Society. "The effect on the retina when the eyes have been fixed intently for a few seconds on a brightly-illuminated coloured object is well known; the colour complementary to the one looked at always appears when the gaze is removed to a colourless surface. It is also a matter of common observation that when the eyes have been directed to a bright light for a short time, the image left on the retina as seen when the eyes are averted is *dark*; but if the eyes are rapidly opened and closed the image is still seen *bright*. I am not aware, however, that it has ever been noticed that this image varies in size according to the distance of the background to which the eyes are directed. A circle of gas-jets, perhaps, affords the simplest test. It will be seen after looking at the circle of light for a few seconds—in some cases a more or less lengthened gaze at the light is necessary, owing to the varying sensitiveness of the retina—that, if the vision be turned to a distant background, the size of the image is instantly enlarged, and then, if the eyes be directed to a near background, the image is reduced in size. If any difficulty should be found in seeing the reversed image of the gas-jets, it may readily be seen as a bright object by rapidly closing and opening the eyelids. The effect is the same as if the image were seen through a cone—the apex of the cone being held close to the eyes. In other words, the effect is the reverse of the ordinary rules of perspective."



"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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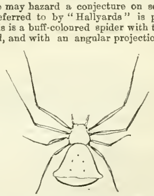
CONVENTIONAL EVOLUTION.

[1790]—Kindly allow me to make one or two suggestions upon what has been happily termed "Conventional Evolution." Every great teacher has followers who lay undue stress upon certain of his doctrines; and sometimes it happens that such doctrines are the least proven, as universal truths, by the master. This, I think, has been the case with Darwin. He certainly relied very much upon small variations in expounding his theory of "natural selection"; but it is doubtful whether he would have made them a *sine quâ non*, as his disciples do. Cataclysm and special creation were the favourite hypotheses of our forefathers. We have now gone to the other extreme, and nothing but a growth by infinitesimal gradations will suit us. No kind of break is tolerated. It is assumed that Nature is opposed to any sort of leaps, and, in accordance with that idea, many of our present teachers point to an imaginary chart of brutal ancestry descending by a slow unbroken chain to the parent man—ape. The "missing links," of course, may yet be found, but till they are why draw so largely upon imagination? Has Nature no phenomena by which the breaks can be explained? Does she never pass abruptly from law to law? The author of the "Vestiges" made such a suggestion, but no one, it seems, has ever followed it up. In chemistry we pass from one substance to another by sudden steps. You cannot link calomel to corrosive sublimate by gradations of chlorine. The diamond, too, enters suddenly under the control of laws which have no apparent concern with common charcoal. But leaving the inorganic world on one side, what are we to say to the leap Nature makes in creating a Shakespeare or a Beethoven? Can we lead up to them by a slow ascending series of their ancestors, or do they suddenly appear, like Minervas, fully formed?

I had something to say about Darwin's law of correlation being so much neglected of late, but I am afraid I have already taken up too much space. GAMMA.

SPIDER.

[1791]—If one may hazard a conjecture on so short a description, the spider referred to by "Hallyards" is perhaps *Thomisus abbreviatus*. This is a buff-coloured spider with the body abruptly bent down behind, and with an angular projection on each side of



the upper part at the edge of the bend. But it has *five* small pits on the upper surface. Some members of this genus are found in flowers, and I have seen one so closely resembling in colour the flower (a composite one) amongst whose florets it was lying in

wait for prey, that it was with great difficulty detected. I enclose a sketch of *Thomisus abbreviatus*, which may perhaps enable "Hallyards" to decide whether the determination is correct.

E. A. Butler.

THE PREVENTION OF COLLIERY EXPLOSIONS.

[1792]—How many more colliery explosions are we to hear of without preventive measures being at least attempted? Can any expert inform me what would be the cost of the installation of the electric light in mines? Herr Julius Maier, in a recent article in the *Fortnightly* on "Electricity," has proved that the mine-lighting question by electricity has been brought within the range of practical possibilities; and I myself, two years ago, heard Professor Tyndall confess it could be managed, and these terrible disasters averted, if it were not for the expense. Surely some association or society might be formed to collect funds for such a purpose. The British public is ever ready to come forward upon charitable pretexts, and if once it was fully understood that the illumination of mines by electricity was not an impossibility, subscriptions would be forthcoming. Science, who never turns her back upon us when we need her aid, can help our poor miners now if man will let her.

M. E. Mavrogordato.

ROCKS OF CHARNWOOD.

[1793]—I am pleased to know that my article on Charnwood has led Mr. Fletcher and his friends to study the remarkable rocks of that region. The quarry which he describes in Brazil Wood is clearly the one to which I referred, and I am glad that he saw clear evidence there of the intrusion of the granitic into the slaty rocks. If he visits the spot again, I hope he will search for the garnets which have been plentifully developed in the altered slate. I found them most abundantly in the corner farthest from the gate. They are dark—nearly black—in colour, and vary in size from microscopic dimensions to about the eighth of an inch in diameter.

The pebbles and gravel lying on the top of Mountsorrel hill—some 200 feet above the level of the Soar Valley—probably mark the stage of depression which followed the deposit in England of the great chalky boulder clay—itself the moraine of a mighty glacier. England went down, perhaps, 2,000 feet in the west and south, but much less in Leicestershire; perhaps not more than 400 feet. Still, this change would be quite sufficient to submerge most of the Charnwood hills, including Mountsorrel, and during the washing and redistribution of the surface boulder clay which then took place, the pebbles now forming a thin covering to the hill-top may have received their rounding.

But Mr. Fletcher states that he found bones and fragments of pottery in the *lower* part of the stratum containing the pebbles. This I consider to be owing to the fact that the stones have been moved partly down the hill by rain, &c., since the time of their original deposition. The real summit of Mountsorrel—long since quarried away—was much higher than the part which now remains. All such exposed summits get washed bare, and the *débris* is pushed down the slopes. I may add that a fine flint javelin-head which I found in probably a corresponding position to the bones, &c., in 1876, would possibly be coeval with them, and that bones, pottery, and all are, I should consider, referable to a period somewhere about the time of the Roman occupation of this country. A comparison with the numerous specimens of pottery in the Leicester Museum would help in settling this point.

I may add that I think it would be a good thing if local workers in science would favour us more frequently with short, condensed notes on matters which come under their observation. It is certain that many useful and interesting facts are lost to the world of science, for, though observed, they are not recorded.

W. Jerome Harrison.

TWO-SPEED GEARING.

[1794]—In reply to "W. J.," Bown's two-speed gearing performs excellently, provided it is so adapted to a tricycle that it can be changed from power to speed easily. John Browning.

A PARADOX.

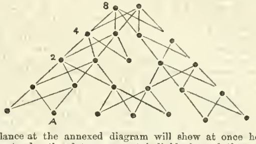
[1795]—Your correspondent "Coleford" (1772) propounds no "paradox." His theory of the rate of increase of grandfathers, great-grandfathers, &c., only holds good if there is never such a thing as an inter-marriage between two people descended from the same ancestors, however remotely they may be connected. Each grandfather represents a family one degree removed, each additional great-grandfather another family two degrees removed, and so on.

Again, it is in no way necessary, as "Coleford" seems to think, that all the great-great-grandfathers or great-great-great-grandfathers should "exist on the earth at one time."

But, in the first place, families cannot help intermarrying as I have indicated, and, in the second place, it is not unusual for a husband to be old enough to be his wife's grandfather. R. L.

[1796]—The solution of the rather curious paradox which occurs upon page 533 is to be found in the following simple facts:—Although every single individual in ordinary parlance is said to possess two grandfathers, four great-grandfathers, &c., these various antecedents are at once, grandfathers, &c., to many other individuals.

Moreover, when marriage is contracted between members of the same family, as is often the case among certain African tribes, it occasionally happens that a person has but *one* grandfather, his father's father and his mother's father being one and the same.



A glance at the annexed diagram will shew at once how the matter stands; the dots represent individuals, and those at the extremities of each angle indicate the parents of the person forming the apex thereof pointing downwards. From this it will be seen that if we allot to any individual in the lower line (A for example) his common share of ancestors, he will posses a grandfather on his mother's side and another on his father's side (apparently two, but in reality only one); the fathers of these, and of their wives, make four great-grandfathers (still represented by one) who, with *their* wives, are the offspring of eight great-great-grandfathers (the complete eight, as a matter of fact, being a single individual of the first pair). Again, ten boys, each having a father, should make ten fathers in all, but if the boys are brothers there is only one father. All humanity must be more or less related, and the evident reason which your correspondent requires why the population increases instead of decreasing, is because in almost every case a grandfather has more grandchildren than a single grandchild has grandfathers. Alex. Mackie.

[Solutions are also sent by "Scotus," George Falkner, F. W. H., &c.—Ed.]

SYMMETRY.

[1797]—I admit, in common with "An Old Draughtsman" (1742), that questions of taste frequently appear to be very complex. But is he right in using the word "symmetry" as synonymous with balance? Surely he is not. Nevertheless, he does not stand alone in this misuse of the word; it occurs over and over again in journals devoted to art subjects. Equiformity, or equipoise, is not symmetry. Symmetry, according to our dictionaries, means harmony of proportion—the proportion of the several parts to the whole together. A work either of Nature or of art may be equipoised without being symmetrical. As to the complexity of matters of taste, it may be said that it frequently disappears as soon as the end to be attained can be clearly formulated.

Another Old Draughtsman.

LETTERS RECEIVED AND SHORT ANSWERS.

W. C. Penny was horribly shocked (as well he might be) to read on p. 535 a description of a breakwater which "consists of a number of small boys (!) to be so fastened together that each may float on the water." Thank U.—John Silcock knows of a lot of small boys who would suit admirably, and would arrange with the inventor to supply them.—Thos. Radmore. Thanks for light thrown on the matter. I am a little afraid that that Blue Book is lost in the abyss of the office.—Joseph Homer. Articles sent here "in July, 1883," and unaccompanied by stamped and directed envelopes, must, ages ago, have departed to that bourne whence no MS. returns.—Miss Jennie McNeil. The libration in longitude of the moon varies at each successive lunation, and has to be calculated separately, by a somewhat operose formula. The full moon of June 27 will have passed ere these lines are in print; but in the case of the succeeding one (that of July 26) the

libration in longitude will bring more of the western part of the surface into view.—Augustus J. Harvey urges the necessity for national electrical engineering and phonetic training colleges. He is also anxious for the establishment of hospitals for self-mesmerism or self-healing, though why a man cannot cure *himself* at home he fails to explain.—Dr. Knight sends comments on a decision (against him) of a local County Court Judge. This is not, however, the place to review legal judgments in.—W. Robinson points out, in connection with the article on p. 515, that the omission of any reference to a movable pulley makes it read as though, the rope being simply passed over one fixed pulley, overhead power was in some way gained, the fact being that, under such circumstances, it would need a little over 100 lb. pull upon one end of the rope to pull up 100 lb. at the other.—John Parry. About as much connection with the scientific doctrine of chances as it has with the Rig-Veda. You will find the concoctor of it described in the 5th Geo. IV., c. 83, s. 4.—An Insulted Lover of Knowledge who Detests Humbug. I have received your courteous, logical, and gentlemanlike letter. See section 3 of final paragraph on p. 505 of last volume. Let me implore you to keep your temper.—James Edmonds. The bright disc of the sun which we see, and which astronomers call the "Photosphere" is a species of self-luminous cloud surrounding the sun; just like our clouds, only made up of metallic vapours instead of water. It is needless to say that the temperature must be stupendous to maintain metals in a gaseous form. Well, such spots as you saw are depressions in this photosphere. If you have ever watched the water in a mill-pond, near the penstock or sluice, you will have noticed how the surface exhibits little funnel-shaped depressions. Now, in some way ill-understood, it is supposed that sun-spots have their origin in a somewhat similar sucking down of the matter of the photosphere, and the cooler gases, of course, brought down from above would look darker than the surrounding highly-heated ones. The nucleus of the spot, which seemed to you black by contrast, would be unbearably brilliant if it could be isolated. You should read "The Sun," by the Conductor of this journal, or the volume with the same title by Professor Young, in the "International Scientific Series."—J. V. Hall suggests to "Hallyards" that he should comment on "commence" for "begin," "penetrate" for "pierce," and, in fact, on the employment of words of Latin origin generally, when Saxon ones exist and are more expressive. We have largely to thank Dr. Johnson for this depravation of the English language. "Hallyards" resides permanently on the Continent.—H. R. B. I recognise the justice of much which you advance; but you must bear in mind that the dicta in question were put forth as those of a dead woman of the highest literary ability, and of almost world-wide fame (or notoriety), and neither as arguments, nor with any expression of approval. I suppose that if I reproduced a conversation here in which Spinoza was an interlocutor, you would accuse me of admitting evidence for Pantheism! You, however, yourself, did unquestionably trench on theological ground, inasmuch as yours was a categorical contention for positive miraculous interference in explanation of a phenomenon of nature. It did not strike me that "Ultra-gas" was advanced to explain the action of gravity. The whole question you raise is a delicate and difficult one. See first reply to Dr. Lewins, for example, at the beginning of p. 534, in illustration of what I have to contend with.—General Babbage. Can any possible advantage accrue from protracting the discussion? As for "calumnies," had the late Mr. Sheepshanks and the present Sir George Airy (to name only two people) nothing to complain of in that respect? In cases of "Athanasius contra mundum," I always think myself that the odds against the saint being right are overwhelming.—C. Turner. Should have been sent to the publishers.—W. As it will apparently gratify you to have the last word, by all means do so. I can only deplore, for the sake of Knowledge that you do not edit it. Its circulation could hardly fail to rise another 25,000 a week, or so, *per saltum*.—D. Tattersall. To varnish a map you must first size it. The size is made by boiling clean parchment cuttings in an earthenware pot and straining it. Two coats of this should be first brushed over your map. Then, when all is thoroughly dry, varnish it with "Crystal varnish," which you can buy at the shops. Mind and use a large flat brush, and do not drive the varnish too bare. Do it in a warm place. The magnifying power of your telescope is 30 diameters.—J. H. Ward should consult the previous articles on the same subject which have appeared here. I question if such a table of the average dimensions of the various parts of the body as you ask for exists, or could be compiled. Your idea that people in whose outstretched arms a line passing through the middle of the inner fore-arm passes when produced inside the shoulder-joint are more remarkable for mental than physical perfection, can only be established or disproved by observation.—I. J. Collins. You are, I imagine, under a delusion as to the general benefit of the operation to which you refer. It *may* be beneficial to some of the filthiest and most degraded races in hot climates, but (as any Indian doctor will tell you) no white man with the average cleanliness of our race, ever has the very slightest need for it in the tropics; while you have only to consult the first qualified medical man you meet to learn how baseless your notion is of its advantage in this country. Forgive me for saying that your whole reasoning is fallacious. It is Art and not Nature that perpetuates hereditary disease by keeping people alive who would infallibly succumb but for its aid. How long do you think the breed of racehorses would remain pure—or fancy pigeons continue without reversion to their ancestral form of the blue rock, but for the most diligent and watchful care on the part of breeders? All this cuts at the very root of your argument.—James Ellis, in ascending a dry sewer-shaft in Leeds about a year ago, discovered a half-grown frog, with its mouth (seemingly) entirely sealed up. This he gave to a local medical practitioner, who kept it in a Ward's case; where, for some time, no alteration in its mouth took place. Upon the production of the frog, however, for the inspection of some naturalists, it was found to have adapted itself to its changed circumstances, and, under the influence of light and the presence of insects, to have opened a mouth useless to it in the blackness of darkness of the sewer. Our correspondent's idea is that the frog was developed from some spawn thrown away in the water in which some watercresses had been rinsed. Having kept batrachians for many years, I can myself say that when they hybernate, either inspissated saliva, or something, does form a kind of skin, which makes it very difficult for them to open their mouths on their return to their usual life.—Dr. Curran. Received with thanks. Will communicate with you by-and-by as to your idea of reproducing them.—W. H. Greene. Thanks, but crowded out for want of space.—Dr. Lewins. I am entirely with you as to the utter unsoundness and untenability of much which you assail; but when you proceed categorically to assert, in effect, that matter is eternal, and that what the overwhelming majority of mankind agree in calling mind, soul, or spirit is immanent in it, and neither has, nor can have, any separate existence, I can only regard such assertion, in the existing condition of our knowledge, as (in Scottish legal phraseology) "not proven." All I can say is 'Αγνοέω.—Commentator. The Conductor returns to England in a week or two (see p. 527 of last volume), and it shall be submitted to him. Once more, thanks for artistic picture.—J. C. Clanchy. Utterly out of place in a scientific journal, however suitable to a trade one.—Hallyards. "Est modus in rebus; sunt certi denique fines quos ultra citraque nequit consistere" decorem. If the *Times* can afford to hint at one of your illustrations, *I* can't—I can't indeed. The entire subject savours *de la saleté;* and I was sorry afterwards that I did not merely acknowledge the receipt of that correspondent's letter, instead of replying to it in a form to provoke a rejoinder. Would you like your MS. returned?—Howard G. Tozer.—The Conductor will receive your letter on his return to England later on in the month.—F. W. Kind. (1) There is no better work than Schmidt's "Doctrine of Descent and Darwinism," published in the "International Scientific Series," by Kegan Paul, Trench & Co. (2) There is no such a thing as a cheap scientific dictionary, (3) nor does such a pamphlet on engineering as you ask for exist. (4) The volumes of the "Chandos Classics," published by F. Warne & Co., contain editions of the poets suitable to your wants. (5) This question is simply an impertinence. What business have you, or any one else, to inquire into the editorial arrangements of this journal?—F. W. H. Doyle. (1) The orbits of the planets are by no means accurately in the same plane. That of Mercury is inclined 7° to the ecliptic or plane of the earth's orbit; Venus's 3°; Saturn's, $2\frac{1}{2}$°, &c.; while among the planetoids the inclination of Pallas's orbit is nearly 35°. If, though, as is supposed, the whole solar system had a common nebulous origin, its components would naturally be spread out approximately in the plane of the equator of the original rotating vaporous mass. (2) The path of any body describing an orbit—or even passing only once round the sun—depends upon the direction in space from which it approaches him. (3) From the elementary principle that "action and reaction are equal and opposite." The air rushing out drives back the vessel containing it precisely with the force with which it does so issue, and as that vessel is, necessarily, attached to your hypothetical ship, it is not hard to see why the latter remains unaffected. Did you ever try to lift yourself by the waistband of your own trousers?—E. C. H. If you were standing at either flank of a company of soldiers firing, of course not a bullet would go near you. If you, however, stood straight in front of the file which happened to be shooting, the passage of one or two ·455 bullets through your person would indicate with sufficient clearness what was going on. To be consistent, though, you ought to maintain that under the former circumstances there was no firing at all!

Our Inventors' Column.

*We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (*KNOWLEDGE *being a popular magazine) than is accorded by the most excellent trade journals*

COFFEE MACHINE.

[Patent No. 11,728. 1884.]—This invention of Mr. L. Hamel, 42, Basinghall-street, E.C., is a contrivance for simultaneously roasting, grinding, and infusing coffee in one machine, and by these means combining all the necessary materials for making the freshest coffee, retaining its aroma, and effectually preventing any adulteration.

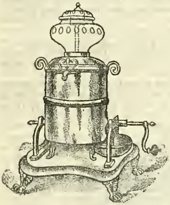


Fig. 1.

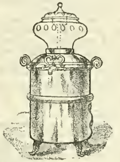


Fig. 2.

The machine (Fig. 1) consists of a coffee-pot on a stand, upon which, and beneath the coffee-pot, a coffee-roaster (Fig. 3) revolves in various directions by a novel eccentric motion, upwards, downwards, and from side to side, and to which roaster a coffee-mill is attached. The lamp or burner beneath it boils the necessary water for infusion, and at the same time roasts the berries which, as soon as roasted, are automatically emptied into a hopper, where it is ground by the mill attached to the roaster. Thus the whole process of roasting the green coffee-berries, grinding, and infusing the same is simultaneously performed within about fifteen minutes.

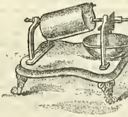


Fig 3.

The coffee-pot is so arranged that, if required, it may be easily removed from its stand. The stand, also, when the coffee-pot is removed, will roast and grind the coffee simultaneously, and the ground coffee might then be used for any other pot. Either a gas-burner (where this is convenient) may be used, or a spirit-lamp; those in use by the inventor are of a peculiar construction, for whilst the gas-burner may be so regulated as to heat the roaster and boiler, either together or separately, the spirit-lamp, by a simple contrivance, may be regulated in every necessary direction, and will automatically be extinguished under the roaster when the berries are roasted, whilst it still keeps the water boiling, and will also automatically be totally extinguished when the infusion is completed. The machine is exhibited in the Inventions Exhibition.

Our Chess Column.

BY MEPHISTO.

BRITISH CHESS ASSOCIATION.

ON Friday last the series of consultation games between five sets of players commenced. There are three prizes, of £5, £3, and £2. Each set plays with the other, therefore each party will have to play three games. The following are the names of the consulting players, each set, according to the conditions, consisting of a first-class player and an amateur:—

Gunsberg and Hunter, | Mason and Donnisthorpe,
Bird and Hewitt, | MacDonnell and Pollock.

Mason and Donnisthorpe adopted the French defence against Bird and Hewitt, and succeeded in gaining a Pawn in the opening. The end-game increased their advantage, and they won.

Gunsberg and Hunter played the centre gambit against MacDonnell and Pollock. This game soon assumed an open and interesting character, as may be seen from the opening moves given here:—

White. G. and H.	Black. McD. and P.	White. G. and H.	Black. McD. and P.
1. P to K4	P to K4	10. Kt to B4	P to Kt4
2. P to Q4	P × P	11. B to K3	Q to Kt3
3. Q × P	Kt to QB3	12. Castles	Q × P
4. Q to K3	B to Kt5 (ch)	13. B × B	RP × B
5. P to B3	B to R4	14. Q × QP	B to B4
6. Q to Kt3	Q to B3	15. Q to K5 (ch)	Q × Q
7. B to KB4	P to Q3	16. Kt × Q	R × P
8. B to QKt 5	B to Kt3	17. Kt × Kt	P × Kt
9. Kt to Q2	P to KR3	18. B × P (ch)	K to Bsq

The game extended to seventy moves, and was not finished till Saturday. White in the end game remained with a Kt against a B and a passed P on the KR file, and ultimately won.

An interesting event—the Solution Tourney—was decided on Saturday. The Problems, a four-mover and a three-mover, given below, were submitted on printed diagrams to the competitors, who had to solve them without the use of board and men. Mr. Gunsberg was the first to hand in complete solution of the four-mover, and he therefore took first prize of two guineas; Mr. Bird took the second prize. Mr. Herbert Jacobs took the prize for the best and most rapid solution of the three-mover. Monday, the 29th ult., the chief event of the Tournament was decided. Gunsberg defeated MacDonnell in the game given herewith. He next played Mills, but through an oversight in the ending the latter was enabled to draw. However, Hewitt drew with Bird at the same time, which again brought the score of the leading players to their former relative position, namely, Bird, 10½ out of 13 games played, Gunsberg, 12 out of 13, Gunsberg needing but one more game to win, as Bird's highest possible would be 12½. Guest, late in the evening, made up the deficiency by losing the adjourned ending to Gunsberg, who, therefore, with a score of 13 out of 14, has practically secured, the first prize. He may, however, still increase his score by another win.

SOLUTION TOURNEYS.

Motto—"Sat Sapienti."

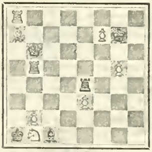
(From the "CHESS-MONTHLY" Problem Tournament.")

BLACK.

WHITE.

White to play and mate in four moves.

BLACK.



WHITE.

White to play and mate in three moves.

Another consultation game was played on Monday, in which Mason and Donnisthorpe were opposed to MacDonnell and Pollock, who won the toss for the move. The former players again adopted

the French Defence, the game proceeding evenly, till, in the middle part of the game, MacDonnell and Pollock exposed their King's side by an advance of the KKtP. Mason took advantage of this weakness with his well-known judgment and ability, and again came off victorious. Gunsberg and Hunter began a game against Bird and Hewitt on Saturday. The former players got a disadvantage in the developing moves of the French Defence, but the game had to be adjourned. The game was finished on Tuesday, and Bird and his partner won.

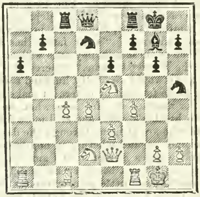
Complete score of the B. C. A. Tournament up to Tuesday eleven o'clock p.m., inclusive:—

—	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Total.
H. E. Bird (A)	—	1	0		½	1	½	1	½	1	1	1	1	1	1	1	11½
W. Doniathorpe (B)	0	—	0	0	0	1	1	1	0	1	1	1	1	1	0	0	8
J. Gunsberg (C) ...	1	1	—	1	1	½	1	1		1	1	1	1	1	½	1	13
A. Guest (D)		1	0	—		1			1	1	½		0	1	1		6½
Thos. Hewit (E) ...	½	1	0		—	0	0	1		1	0	½		1	0	1	6
D. Y. Mills (F)	0	0	½	0	1	—	0	0	0	1	0	1	½	1	½	0	5½
Rev. McDonnell (G)	½	0	0		1	0	—	0	1	1	1	1	1	½	1	1	10
J. Mortimer (H) ...	0	0	0		0	1	1	—	½	1	0	1		0	0	1	5½
R. Loman (I)	½	1		0		1	0	½	—		0	1	1	1	1	1	8
W. Mackeson (J) ...	0	0	0	0	0	0	0	0		—	0	0		½	0	0	½
W. H. K. Pollock (K)	0	0	0	½	1	1	0	1	1	1	—	1		1	1	1	9½
R. Rabson (L)	0	0	0		½	0	0	0	0	1	0	—	0	0	0	0	1½
H. A. Reeves (M) ...	0	0	0	1		½	0		0			1	—	1	0	1	4½
Rev. J. de Soyres (N)	0	0	0	0	0	0	½	1	0	½	0	1	0	—	0	1	4
G. E. Wainwright (O)	0	1	½	0	1	½	0	1	0	1	0	1	1	1	—	1	9
A. Rumboll (P)	0	1	0		0	1	0	0	0	1	0	0	0	0	0	—	3

POSITION in a game played June 27, between Messrs. MacDonnell and Loman :—

R. LOMAN.

BLACK.



WHITE.

G. R. MACDONNELL.

White won the game in sixteen moves in the following forcible manner :—

1. P to Kt4	B × Kt
2. BP × B	Kt to Kt2
3. B to R3	

Well played! Black must either lose the exchange or submit to White's next move.

3.	R to K sq.
4. Q to B2	Kt to Kt3

Black has no good reply. If 4. P to B4. 5. P × P en pas, threatening the Kt and also P to B7 (ch).

5. Q × P (ch)	K to R sq.
6. P to R3	

One of those moves with which experienced players wait on youngsters. It serves the (ostentatious) purpose of providing against a possible excursion of her majesty to Kt4 at any future time, but it also invites Black to take the bait on B4.

6.	Kt × P

The sprat has been swallowed. Black ought to have challenged the Queen.

7. Kt × Kt	R × Kt
8. B to K7!	Q to B sq.
9. B to B8!	Kt to B4
10. R × Kt!	

It may now be seen that White's 8th move was necessary to enable him to get the check on B6.

10.	R to B8 (ch)
11. R × R	Q × R (ch)
12. K to Kt2	Q to B7 (ch)
13. K to Kt3 and mate in three moves.	

The following game was played June 29th in the Tournament :—

IRREGULAR OPENING.

White. Rev. G. A. MacDonnell.	Black. J. Gunsberg.	White. Rev. G. A. MacDonnell.	Black. J. Gunsberg.
1. P to KB4	P to Q4	15. B to K sq.	Q to Kt4
2. P to K3	P to QB4	16. K to B2 (h)	Kt × KP (i)
3. Kt to KB3	P to K3	17. P × Kt	P to Q5 (j)
4. B to K2	B to K2	18. P × P (k)	Kt × B
5. Castles	B to B3 (a)	19. P to Q5	Kt × RP
6. P to Q4	P to B5 (b)	20. R to KKt sq.	Q to B5 (ch)
7. Kt to B3 (c)	Kt to B3	21. K to Kt2	Kt × P
8. Kt to K5 (d)	KKt to K2	22. K to R3	Q to R7 (ch)
9. P to KKt4 (e)	B × Kt	23. K × Kt	Q × R (ch)
10. BP × B	P to QR3	24. K to B4	P to Kt4 (ch)
11. B to Q2	P to QKt4	25. K to B3	P × P
12. P to QR3 (f)	B to Kt2	26. B to B2	P to Q5 (ch)
13. B to B3	Kt to Kt3	27. Kt to K4	B × Kt (ch)
14. P to Kt3 (g)	Kt to R5	28. K × B	Q × B
		Resigns	

NOTES.

(a) Any developing move would be more in conformity with the defence in close games.

(b) Owing to his previous move, Black is now committed to advance this Pawn.

(c) White should have proceeded immediately to break the adverse Pawns, with 7. P to QKt3. If 7. ......P to Kt 4, then 8. P to QR4. If 7. ......P × P, then 8. RP × P, with an open Rook's file and united Pawns.

(d) 8. P to QKt3 would still be advantageous.

(e) Undoubtedly the cause of White's subsequent troubles.

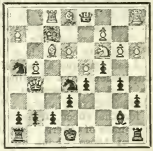
(f) To prevent 12. ......P to Kt5; but the remedy is worse than the evil. The simple way would have been 12. B to B3, followed by 13. Kt to K2, &c.

(g) The game being once compromised on the Queen's side, and an attack threatened on the King's wing as well, White ought to have devoted his attention to the more important defence of the King's position.

(h) 16. Q to K2 was preferable.

G. A. MacDonnell.

WHITE.



BLACK.

J. Gunsberg.

(i) As sound as it is effective.

(j) If 18. B × B, then 18. ......Q × P mate.

(k) 18. Q × P, although leaving Black with a better game, still would not have led to such sudden disastrous consequences.

SEVERAL correspondents have written respecting the termination of the game between W. Donnisthorpe and J. Mortimer, KNOWLEDGE, p. 558. It seems that the game can be drawn as follows :— 1. Kt to Q7 (ch), 2. K to R7 (the only move), P to R8 (Q). 3. Kt to Kt3 (ch), K to B5. 4. Kt × Q. K to B6, and draws.

Mr. R. A. Proctor's Lecture Tour.

1885–6.

Subjects:

1. LIFE OF WORLDS	4. THE PLANETS
2. THE SUN	5. COMETS AND METEORS
3. THE MOON	6. THE STAR DEPTHS

Arrangements are now being made for the delivery of Lectures by Mr. Proctor from August onwards. Communications respecting terms and vacant dates should be addressed to the Manager of the Tours, Mr. JOHN STUART, Royal Concert Hall, St. Leonards-on-Sea

KNOWLEDGE
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CONTENTS OF No. 193.

FEMININE VOLUBILITY.

By THOMAS FOSTER.

AMONG the minor miseries of life, which become by frequent repetition, and by steady continuance, very serious troubles, perhaps the querulous volubility of kindly women, is as apt as any to embitter life. The scolding vixen is endurable by comparison with the unselfish woman, whose anxiety for the welfare of those around her leads her to make them all exceedingly uncomfortable. I can imagine a man of sense exposed to the angry vituperations of a Xantippe, finding in them after awhile a fund of amusement. I cannot imagine such a man becoming very angry with a mere shrew, save perhaps for the effect of her vile temper on the comfort and happiness of others. But it is different with the complaints of those whom we know to be well-meaning. Their querulousness is infinitely more trying, because we cannot separate from our sense of annoyance the sense of utter incongruity between the object they really have in view and the effect they as a matter of fact produce.

A vixen's anger may be compared to a storm which interests more than it annoys; the complaints of kindly but over-anxious women resemble the steady downpour of rain, the purpose of which is excellent, but the effect while it lasts most wearisome and annoying. One cannot get angry with rain or drizzle, but one can get no comfort out of it; whereas one can enjoy the sense of opposition roused by a fierce storm through which one may have to make a way.

I recall here, by the way, that George Eliot, who noted more closely than most persons the sources of domestic happiness and misery, has dwelt on this difference between the mere vixen whom everyone contemns and the Mrs. Gummidges who trouble those around them by constant complaints which have their origin in over-anxious love. "Women who are never bitter and resentful," she says, "are often the most querulous; and if Solomon was as wise as he was reputed to be, I feel sure that when he compared a contentious woman to a continual dropping on a very rainy day, he had not a vixen in his eye—a fury with long nails, acrid and selfish. Depend upon it, he meant a good creature, who had no joy but in the happiness of the loved ones whom she contributed to make uncomfortable—putting by all the tit-bits for them, and spending nothing on herself—a woman at once patient and complaining, self-renouncing and exacting, brooding the livelong day over what happened yesterday, and what is likely to happen to-morrow, and crying very readily both at the good and the evil."

How many families know this kind of good woman, and the misery her voluble manifestations of anxiety occasion to every one within range of her voice. She is generally possessed with the notion that much more depends on her than is actually the case. But one feels that it would be unkind to tell her so. Her volubility about her multitudinous cares and anxieties produces a distressed silence among those around. The thought of all—that matters would go well enough if she could but leave them a little alone—is expressed by none. Wearily she laments what is past and cannot be altered, or proclaims anxieties about what may never happen. Over and over again, in ever-varying forms, the same imagined troubles or long-past misfortunes are lamented over with wearisome iteration,—and the patient hearers, among whom may be those who have the real work of keeping things straight, can never find courage to ask for some remission of their misery. She gets at last, the idea that the ceaseless worry which deprives all around of half the comfort of life, is all that preserves the family from rack and ruin. "Your father has all his worry abroad," one of these unhappy ones will say, "I have to bear all the worry at home," where—if she knew the real truth she would say, "My husband's work and worry abroad is made for him by others; I make all the worry at home, or most of it,—for him when he comes home tired with his day's work, and still more for the unfortunate folks who are at home through the day."

I sometimes wonder whether in homes made miserable by constant worries of the kind I am dealing with, the kinder way would not be to speak plainly, even at the risk of causing some little pain, or even at first somewhat sharp and bitter pain. At the outset, were not fathers and husbands too apt to be unduly indulgent, the querulous humour might, I believe, be easily checked. I know that most men put up with it as a feminine weakness which should be indulged; they even deem it a part of manly duty to be patient under the infliction. If no one suffered but the husband or the father, there might be little harm in this mistaken view of duty. But the case is otherwise. Many suffer besides him. Amongst others none suffers in the long run more than the offender herself. She may not consciously recognise how wrong her conduct is, or how much misery it causes; but it does make her unhappy both directly and indirectly, directly as her growing querulousness shows, indirectly because she cannot but feel that those whom she wishes to see happy are uncomfortable if not miserable while she mourns and laments on their behalf. For want of a few words of good advice, or even, if necessary, of very definite warning and *command*, many a well-meaning woman has made her own life and the lives of those dear to her, a long spell of discomfort where they might have been most happy, and has ended by alienating the heart of the man who had not the heart to check at the right time, her querulous ways. There is more true love in kindly severity of rebuke before the mischief is done, than in

mere patience to bear the misery—patience which after all may be at last overworn, or remaining, may become the patience of disgust instead of the patience of love.

GROWTH OF A FAMILY.

By Richard A. Proctor.

Mr. Francis Galton has expressed a wish to obtain from heads of families statistics about the development of children in height, weight, &c., at various ages. But I imagine he will not get a very large supply of accurate statistics, and that without much fuller information than the average British paterfamilias is likely to supply, the statistics will not be much more valuable than those stupendous collections of meteorological records which thus far have proved such utterly useless loads on official shelves. For statistics are "kittle cattle to shoe behind": properly employed they may lead us to truth, but unless well treated they are apt to project us on the road to error.

Still there can be no doubt that carefully collected and compiled statistics about the development of children would be interesting and valuable. The mere records of the heights of children at different ages, for example, may possess high physiological interest, especially if accompanied by information as to circumstances which may have affected growth.

I have not myself been very attentive to such matters, although so far as numerical relations are concerned I have had as good opportunities as most men. Since 1866 (when the Corner House fell, and by its fall condemned many innocent persons to hard labour for life), I have not been so constantly with my family as Mr. Galton's statisticians are expected to be. Many times I have been away from home for seven or eight months at a stretch; and once I was away nearly two years. And indeed, it has been merely in a casual way that I have taken measurements, usually when by some lucky chance my whole family were gathered together and the question of growth chanced to be started.

I was surprised, therefore, to find that the records I had scrawled on the margin of a certain page, gave so much information as, when analysed, they appear to me to convey. That page is the one in Lardner's "Common Things Explained," in which Quetelet's curve of growth is given. I used to compare the heights of my children with those due to their several ages according to Quetelet's mean curve; and so I naturally pencilled in my notes alongside that curve of comparison.

A short time since I made a clean copy of these pencilled notes. In the course of the work it struck me that a series of curves for comparison with Quetelet's would be interesting. The smaller figure in the accompanying engraving arose out of this idea. It will be seen that the heights for the five children dealt with are shown in curves set down on the same plan as Quetelet's growth curve, so that one can see at a glance whether the height of a child at any age was above or below the average height for that age. (Quetelet's curve corresponds to a height, when full grown, of rather more than 5 ft. 6½ in.)

But I first set out the heights of the different children dealt with (I omit the records of several of my children who died young) as they were recorded on given dates, obtaining the very curious series of curves occupying the larger-scale portion of the drawing.

When I had completed these figures they seemed to me suitable as rough examples of the kind of information we may expect to obtain from family height-records such as Mr. Galton has suggested. Of course, had my records been made in pursuance of a definite plan they would have been better worth publishing.

The figures need little explanation. The progress of time is supposed to take place from left to right, one division to each year in each figure, but the time divisions in the smaller figure are only one-fourth those in the larger. Height is represented vertically, as is natural, one space to three inches in each figure, but the height spaces in the smaller are only one-third those in the larger.

The heights were obtained in a systematic manner. They are the heights in "stocking-feet" (to use an absurd expression), and although I had no regular measuring staff, I secured accuracy by using always a square-edge, slid down a vertical surface until it just touched the head. (Putting a flat surface on the head is a very inaccurate method, as it is not easy to determine when it is level, but with any square surface set with its plane vertical, and one edge against a vertical wall, you can get all the accuracy of a regular height measurer.

The records from which the drawings were made are as follows:—

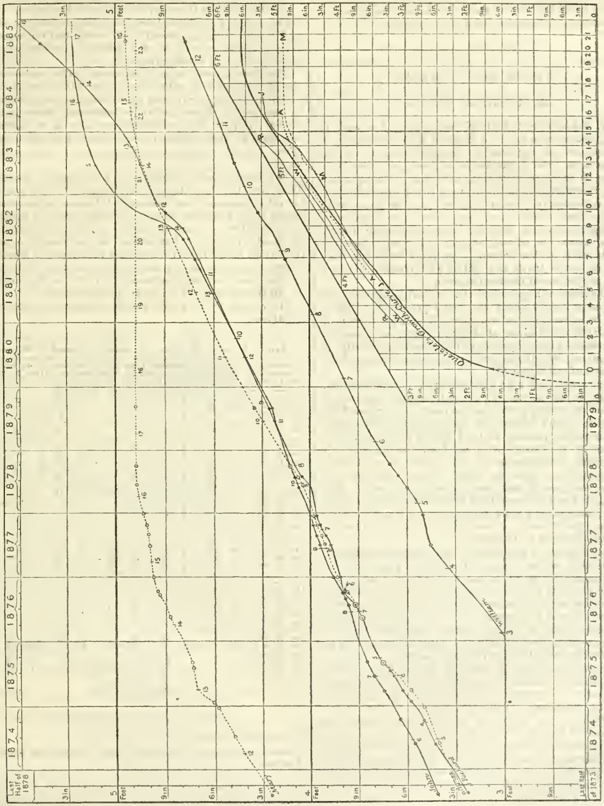
Name.	Mary.	John.	Agnes.	Richard.	William.
Number. Birthday. Ht., Aug. 9, '73.	2nd child. April 1, '62. 4 ft. 2½ in.	5th child. June 18, '68. 3 ft. 4 1/16 in.	6th child. June 18, '69 3 ft. 2¾ in.	7th child. Sept. 26, '70. 3 ft. 2¼ in.	8th child. Feb. 13, '73. —
May 23, '74 ..	—	3 5½	3 4	3 4 1/16	—
July 5, '74 ...	4 4¾	—	—	—	—
Oct. 11, '74 ...	—	3 6½	—	3 5	—
Dec. 9, '74 ...	4 5¾	—	3 4 11/16	—	—
Jan. 24, '75 ...	4 6 1/16	—	—	3 5¾	—
Mar. 27, '75 ..	4 7	3 7⅜	3 5 13/16	3 6¼	—
June 13, '75 ..	—	3 8	—	3 6¾	—
July 13, '75 ...	—	—	—	3 7	—
July 29, '75 ..	4 7¼	—	—	—	—
Sept. 7, '75 ..	4 7 7/16	3 8½	3 7½	3 7½	—
May 15, '76 ...	4 8¾	—	3 8¼	3 8¾	—
June 5, '76 ...	—	—	—	—	3 ft. 1 in.
July 21, '76 ...	4 9	3 9 10/16	3 9 3/16	3 9 3/16	—
Aug. 29, '76 ...	—	3 9¾	—	—	—
Sept. 10, '76 .	4 9½	—	—	—	—
Oct. 5, '76	4 9½	3 10	—	3 10	—
Jan. 5, '77......	4 9¾	3 10½	3 10	3 10⅛	—
June 26, '77 ..	4 10	3 11 3/16	3 11 1/16	3 10⅜	3 4½
Aug. 16, '77 ..	4 10	3 11½	3 11¼	3 11	—
Oct. 21, '77 ...	4 10 1/16	3 11¾	3 11½	3 11½	—
Dec. 16, '77 ..	4 10 5/16	4 0	—	3 11½	3 6
May 15, '78 ..	—	4 0⅝	—	3 11⅜	3 6
June 10, '78 ..	4 10¾	—	4 0½	—	—
July 23, '78 ..	4 10¾	4 0 15/16	4 0¾	4 0 9/16	—
Aug. 31, '78 ..	—	4 1⅛	4 1⅛	4 0 15/16	3 7
Aug. 25, '79 ...	4 10¾	4 2⅜	4 [illegible]½	4 2½	3 9
Dec. 25, '81 ...	—	4 7⅛	—	4 7	4 1⅝
April 18, '82 ..	—	4 7⅝	—	4 7½	4 2½
Sept. 19, '82 ...	—	4 10½	—	4 9	4 3¼
June 24, '83 ..	—	5 1½	—	4 10½	4 4½
May 13, '85 ...	—	5 2⅜	4 11⅓	5 4⅜	4 7¾

To these I may add one measurement of my youngest boy, who promises to be the tallest, viz.:—

Charles. 13th child. Born Feb. 28, 1882. Height, May 13, '85, 3 ft. 3½ in.

It will be seen from the smaller figure that at the same age, 3 years 2½ months, Richard measured almost exactly 3 ft. 3 in. (If I remember rightly my eldest son was taller than my youngest at the same age.)

But the most remarkable departure I have noticed from the average curve, and as I take it from normal growth, is in the case of one of my step-daughters who, when aged 9 years 7 months, on May 13, 1885, measured



4 ft. $4\frac{1}{4}$ in., a great height, as the average curve shows, for a girl of that age.

I doubt by the way whether Quetelet's curve has the right shape. For it cannot be regarded as a mere accident that all the curves in the smaller figure show a depression compared with the average curve, between the ages of 7 and 12.

I have some records of weight, but they are not trustworthy, as they were taken at different hours of the day, and no account is taken of the weight of clothes.

RAMBLES WITH A HAMMER.

BY W. JEROME HARRISON.

(*Continued from p. 215, Vol. VII.*)

FROM NUNEATON TO TAMWORTH—THE WARWICKSHIRE COAL-FIELD.

THE north-eastern corner of Warwickshire contains a basin-shaped coal-field, whose surface-area is but small, but whose coal-seams, passing under newer rocks, extend far to the south. On the eastern side of the basin there are collieries and remains of many old pits between Bedworth and Polesworth; while on the western side the colliery shafts run in a narrow line south of Tamworth from Fazeley and Wilnecote to Dosthill. The strata consist of dark-blue shales, about 1,500 ft. in thickness, containing five workable seams of coal, whose total thickness is 30 ft. These coal-seams lie near the base of the shales, so far as that is exposed; south of Bedworth they run together to form one seam 26 ft. in thickness, comparable with the "Ten-yard Seam" of the South Staffordshire Coal-field, formed under the same conditions and probably about the same time. Taking the year 1879, we find that the thirty-one collieries then at work raised a little over a million tons of coal. Very near the top of the coal-measures is an interesting band of limestone, which contains a little shell (a *Serpula*), by which it can everywhere be recognised. The same bed is well known in North Staffordshire, and may prove of service in correlating the strata of the various Midland coal-fields—now detached, but probably once continuous. Upon the coal-measures lie red sandstones and marls (2,000 ft. thick) to which the name of *Permian* has been applied, but which many geologists now consider to form the uppermost division of the Carboniferous Formation; these extend southwards to within a short distance of Leamington and Warwick. On the north, east, and west, the true relations of the coal-measures to the surrounding strata are obscured by *faults*—great dislocations of the rocks by which the beds are displaced from their true level to the extent of thousands of feet. (Fig. 1.)

But it is of the rocks which undoubtedly lie *below* the coal-measures in this district that we especially desire to treat. In the maps and sections of the geological survey the coal-seams of Warwickshire are shown as underlain by 2,000 feet of "lower coal-measures," below which is shown "millstone grit" 1,000 feet in thickness. Within the last two years all this has been proved to be a great mistake. The so-called lower coal-measures are actually *Cambrian shales*; while the so-called millstone grit turns out to be a quartzite of at least equally high antiquity. Moreover, *below* the quartzite, a group of volcanic rocks peeps out, which must be assigned to the pre-Cambrian formation, a division which includes the oldest known strata upon the surface of the world.

To see these old rocks, the best plan is first to walk from Nuneaton to Atherstone, a distance of about six miles; or, if time does not permit of the latter town being reached, the main facts may be seen between Nuneaton and Hartshill. Getting out at the Midland Station at Nuneaton, the rock behind the platform is seen to be a much-jointed, reddish quartzite, exactly like that which forms the Lower Lickey Hills, in Worcestershire, and which also crops out round the Wrekin, in Shropshire. Crossing the line, there is a fine section exposed in a quarry close to the canal. Here the quartzite is traversed by an intrusive rock, which Mr. Allport has shown to be a *diorite*, composed of the minerals felspar and hornblende. Looking now to the north-west we find ourselves at the foot of a ridge about 500 ft. high, composed of quartzite, which extends for two and a half miles between Nuneaton and Hartshill. It will be best to walk along the rather abrupt eastern slope of this ridge, and then to return to Nuneaton *vià* Stockingford, which lies on the western side. Crossing the main road at the canal bridge we turn to the left across the fields and begin an examination of the quartzite, which is exposed in a succession of quarries all along its out-crop from Tuttle Hill to Hartshill, the sections

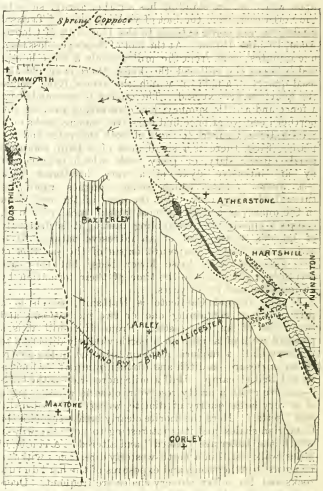


Fig. 1.—The Warwickshire Coal-field. (Scale, 3 miles to 1 in.)

x x x x Pre-Cambrians. Cambrian Shales. Coal-Measures. Permian. Trias. —·—·—·— Railways.

--------Faults. (The arrows show the direction of dip.)

being simply magnificent in number and extent. In a brick-pit close to this point, the Triassic red marls are exposed, having a rather high easterly dip and a disturbed appearance. They are separated from the quartzite by a fault. The quartzite varies in colour from white to red, and contains many specks of decomposed felspar. At its base it is full of angular fragments of felstone and slate, derived from the rocks beneath. Estimating the thickness of the quartzite at 1,000 ft., we find that bands of shale appear about the middle, and as we approach the top these shaly beds become thicker and more numerous. No fossils have yet been found in

the quartzite—not even a worm-burrow—but as it is clearly a sandstone which has been consolidated by the deposition of silica (from heated waters which formerly traversed the rocks) it is possible that fossils may yet be found. It is extensively quarried for road-metal. The prevailing pink tinge of the stone seems to be due to the presence of a little manganese. This quartzite dips to the south-west at angles of from 25 to 45 degrees.

To see the very old—probably pre-Cambrian—rocks which lie *beneath* the quartzite, we must walk along the ridge, which attains a height of 500 feet, to Caldicote Mill. Looking east from this point we see that the rock upon which we are standing has a rather abrupt slope to the north-east, from the foot of which a plain of Triassic sandstones and marls extends to the blue hills of Charnwood, 15 miles distant. At the foot of the slope—less than five minutes' walk from the mill—stands a large house; and between the mill and the house there is an old disused quarry in a field, in which the strata lying below the quartzite are exposed. The quarry is surrounded by a fence and a little spinney, but clambering over at the northern end we at once find ourselves among rocks of a totally distinct nature to those of both the ridge and the plain. First there is a small area of a hard, compact, much-jointed, slaty, or platy rock which is traversed by an intrusive dyke of a very handsome rock —a *quartz felsite*—which sends tongues ramifying through the slaty rock. But the mass of the rock seen in the quarry is a dark—almost black—rock, of a dull, compact appearance, resembling basalt; it is decidedly of igneous origin, and of an intrusive nature. It is unfortunate that no exposure exists of the *junction* of the quartzite with these lower beds, but they are certainly separated as to the time of their formation by an immense number of years.

A mile beyond Caldicote is Hartshill, which is a pretty village, containing one or two modest inns and the ruins of an old castle. From Hartshill it is a pleasant walk of a mile in a north-westerly direction to Oldbury Hall, a modern mansion situated in the centre of an enclosure—a ditch and earthen rampart—which is an old British camp. Half a mile more—across the fields —and we reach a pretty reservoir, close to whose margin is a very large quarry of diorite, worked for road-metal and "setts." Here the diorite clearly breaks through the Cambrian shales, and it is interesting to note the way in which the latter are "baked" and altered. A couple of miles' walk—still in a north-westerly direction—will now bring us to Atherstone, and exposures of the hard dioritic rocks and the softer, shivery shales are frequent. Deep, narrow ravines have been excavated by rain and frost in the shaly beds, while the igneous rocks—the diorites—form round-topped ridges between.

(To be continued.)

THE PHILOSOPHY OF CLOTHING.

BY W. MATTIEU WILLIAMS.

XII.—THE ADVANTAGES OF WOOLLEN CLOTHING.

THE practical conclusion that obviously and directly follows from both series of Rumford's experiments—viz., those on the comparative resistance of the various materials to the passage of heat, and those on their absorption of aqueous vapour—is that a loosely-woven woollen fabric is the best material for clothing, both in winter and summer. Flannel is such a fabric, and its merits are now demonstrated by the unanimous verdict of all who have severely tested it; by athletes, by furnace workers, by sailors, by soldiers, by navvies, &c., especially those who are exposed to extreme fluctuations of heat and cold under the most trying circumstances of profuse perspiration due to violent muscular exertion. A man wearing a superfine black Saxony close-fitting dress suit outside, with a fine linen shirt next to his skin, may be killed by an amount of exposure that he could bear with impunity in loose-flannel "whites."

We understand this now, but it was very different in Rumford's time. He says, "I am astonished that the custom of wearing flannel next the skin should not have prevailed more universally. I am confident it would prevent a multitude of diseases; and I know of no greater luxury than the comfortable sensation which arises from wearing it, especially after one is a little accustomed to it."

More or less irritation of the skin is usually suffered on first wearing flannel; in some cases it continues and is quite serious. Besides this, flannel shirts of good quality, made of pure wool, without admixture of cotton, shrink very vexatiously when washed in the ordinary manner, *i.e.*, when soaped and scrubbed in hot water. Such shirts should be washed in cold water. When I lived in Scotland I was not annoyed by this continuous shrinking of soft flannel shirts, neither by the shirts I wore in Norway, and which I washed daily in mountain streams at my mid-day bathing time, and dried by hanging them to my knapsack. In this country, where we are dependent on laundresses, and may not hang them for boiling flannel shirts, this shrinkage difficulty is rather serious, as it appears to have no practical limit where the boiling propensity prevails.

Writhing under this annoyance, about a dozen years ago I made an experiment which was fairly successful, but atrociously heterodox, and was persecuted accordingly.

I had half a dozen shirts made of "towelling;" that fabric of which old-fashioned towels are made, which is dotted all over with a warty appearance, due to the extreme looseness of the weaving of a portion. These spongy warts project above the general surface, thereby keeping it from continuous contact with the skin, and by virtue of their loose structure they readily absorb the perspiration, as they do the water when the material is used as a towel. My theory was that the fabric, which experience had proved to possess the absorbent properties demanded by a towel, would be well fitted for absorbing the sensible perspiration from the skin. They did this admirably, better than flannel, though I doubt whether they equalled flannel in diffusing the insensible or gaseous perspiration. A certain amount of moral courage was exercised in taking off my coat in the presence of spectators, and the fronts of these shirts were not quite correct for the evening dress of the period.

We are making good progress, however, towards dethroning the despot, Fashion. Country gentlemen are nearly liberated; cravats have gone, the stove-pipe hat is going, and I look forward hopefully to the time when bank clerks, the peculiar people of the Stock Exchange, and other commercial and professional respectables will go to the City in their flannel whites as they now go to cricket and lawn-tennis. When they do so, their employers will discover that the conditions which are favourable to muscular energy in athletic sports are also demanded for the maintenance of that maximum of cerebral activity upon which eminent efficiency in business and professional work depends.

Rumford, when residing in Paris, carried out his principles by wearing white and loose-textured woollen clothing, which, from the sneering descriptions of his French biographers, appear to have been almost identical with the now common Saturday costume at Oxford and Cambridge, and everywhere else in Britain where healthy and sensible young men are free to shake off the fetters of conventional foolery. Rumford was cruelly persecuted by the dandies and salonmongers of Paris, and even by the scientific men of the period, who displayed their superior taste by wearing tight breeches, whaleboned stays, and monstrous super-starched bandages strapped round their necks in such a manner as to render the natural movements of the head impossible.

Referring to his experience, Rumford says, "It is a mistaken notion that it (flannel) is too warm a clothing for the summer. I have worn it in the hottest climates, and at all seasons of the year. I never found the least inconvenience from it. It is the warm bath of a perspiration confined by a linen shirt, wet with sweat, which renders the summer heats of the tropical climates so insupportable; but flannel promotes perspiration, and favours its evaporation; and evaporation, as is well known, produces positive cold." He adds, "I first began to wear flannel, not from any knowledge I had of its properties, but merely upon the recommendation of an eminent physician (Sir Richard Jebb), and when I began the experiments of which I here give an account, I little thought of discovering the physical cause of the good effects which I had experienced from it; nor had I the most distant idea of mentioning the circumstance. I shall be happy, however, if what I have said or done upon the subject shall induce others to make a trial of what I have so long experienced with the greatest advantage, and which, I am confident, they will find to contribute greatly to health, and consequently to all the other comforts and enjoyments of life. I shall then think these experiments, trifling as they may appear, by far the most fortunate and the most important ones I have ever made."

It should be remembered that this, and the account of the experiments, are included in a paper read before the Royal Society, March 22, 1787.

Further practical data have since been accumulated, confirming all that Rumford said in favour of flannel. The most valuable are those obtained by comparing the results of wearing different kinds of clothing upon the general health of large bodies of men whose occupations and other conditions of existence are sufficiently similar to admit of fair comparison.

Experiments of this kind made on soldiers and sailors have resulted in an unanimous verdict in favour of flannel. A striking example is quoted by Dr. Andrew Combe, on the testimony of Captain Murray, of H.M.S. *Valorous*, who, on his arrival in England in December, 1823, after two years' service amid the icebergs on the coast of Labrador, was ordered to sail immediately, with the same ship and crew, to the West Indies. Acting on the convictions derived from previous experience, he directed the purser to draw two extra flannel shirts and pairs of drawers for each man, and instituted a regular daily inspection to see that they were worn. He proceeded to his station with a crew of 150 men; visited almost every island in the West Indies, and many of the ports in the Gulf of Mexico; and, notwithstanding the sudden and extreme transition of climate, returned to England without the loss of a single man or having any sick on board when he arrived. When in command of the *Recruit*, gun brig, which lay about nine weeks at Vera Cruz, the same measures preserved the health of his crew when the other ships of war, anchored around him, lost from twenty to fifty men each. Other sanitary measures were enforced, and, of course, contributed to these results; but the most heretical departure from the naval usages *then* prevailing was this enforced wearing of flannel in a hot climate.

Sir George Ballingall (Lectures on Military Surgery) mentions that when in India, at a time when this subject was but little understood, he witnessed a striking proof of the utility of flannel in checking the progress of a most aggravated form of dysentery in the second battalion of the Royals. I understand that such experience has now led to a general enforcement of the use of flannel belts or wraps by our soldiers when on service in tropical climates. My friend Mr. Sage, of the Army Clothing Depôt, at Pimlico, tells me many thousands have lately been made there.

This demand for abdominal belts or sashes in hot climates is rather curious and somewhat anomalous, but is, nevertheless, well founded. My attention was first directed to it at Constantinople, where I resided during the hottest months of the hot summer of 1843. An intelligent Greek, who had lived there more than thirty years, advised me to adopt an Oriental sash. He had suffered severely at first, other Greeks the same, and all had escaped further attacks of summer dysentery on following the general custom of winding some kind of bandage round the loins. I followed his advice to the extent of wearing a single bandage of flannel next the skin, and from this experience and subsequent observations have concluded that the extravagantly long and cumbrous Oriental sash, wound six or eight, or even a dozen times round on the outside of other clothing, although advantageous in preventing the sudden chills from the evaporation of accumulated perspiration, may be very advantageously substituted by a single envelope of loosely woven flannel, or, better still, of knitted fleecy wool fabric, worn next to the skin. It should be sufficiently elastic to keep in its place without straps.

Its advantages over the extravagant outside sash depend upon the steady and regular absorption and transpiration of the perspiration vapour demonstrated by Rumford's experiments. The ordinary sash acts by absorbing the liquid sweat as a sponge absorbs water. The wearer of the manifold sash becomes a slave to it in consequence of its inducing a delicate and sensitive condition of the over-swaddled skin.

The naked natives of tropical countries do not appear to be troubled with the dysentery which the sash or belt of their clothed neighbours prevents. I suspect that the reason of this is that the mischief is done by a thin covering of cotton or linen clothing becoming wetted by the perspiration, and then cooled by rapid evaporation in a current of air.

The relation of flannel to the secretions from human oil glands will be discussed presently.

THE Society of Arts Conversazione at the Inventions Exhibition on Friday last was a great success, to which the fineness of the weather contributed in no small degree. It was very apparent that no effort had been spared to make the evening an enjoyable one.

THE sixpenny telegram scheme has again been relegated to the official pigeon-hole, although there is just a chance that the outcry against its present abandonment may result in its being re-introduced into Parliament during the present session. In order to meet the anticipated increase in traffic, upwards of half-a-million has already been spent in increasing the wire and instrument accommodation, and the number of clerks has been increased by 1,200.

TRICYCLES IN 1885.

By John Browning.

(*Chairman of the London Tricycle Club.*)

A NEW MACHINE—THE COVENTRY CHAIR.
SMALL WHEELS *VERSUS* LARGE.

ANOTHER new tricycle has just been invented, patented, and brought forward by Mr. A. C. Phillpott.

The inventor has kindly placed the first experimental machine made at my disposal, and, having had it for nearly a week, I have been able to form a tolerably good opinion of its merits. Its great peculiarity is that it combines bicycle-steering—that is, a cross-bar with two handles in front of the rider—with rear-steering.

Bicycle-steering I consider the most efficient of all steering, because it is simple and direct, and there is no rack or pinion to get out of order. Twice I have been within a shaving of a bad accident owing to my steering having been suddenly stopped, caused by mud having got in between the teeth of the rack and hardened, and thus jammed my steering.

Of course, rear-steering is not of itself an advantage, but a rear-steerer can probably be made lighter than a front-steerer; and it can certainly be driven up hill easier. The experimental machine I tried weighed only about 36 lb., and I should think a very light roadster with an efficient break could be made not to weigh more than 50 lb. I found in the model, as it may be termed, of which none of the parts were adjustible, that the pedals were rather beyond my reach, and were some inches too far in front of me, so that I had to work with a thrust, instead of the vertical action I am used to; and the handle-bar was about three inches too low, coming in contact with my thighs.

Yet, with all these disadvantages, the machine behaved fairly well. The steering was better than that of any other rear-steerer I have tried, excepting, possibly, the Rover; and it should be recollected that the Phillpott machine has the advantage of bicycle-steering. I tested the steering as severely as I could, because this was the only point on which I was doubtful of its performance. In the course of my ride I put first one of the driving-wheels, and then the hind steering-wheel over a stone of at least three inches diameter, when running down hill, without causing the machine to swerve at all dangerously.

The steering is very peculiar, being arranged so that a steering-wheel of any size may be employed. For a roadster this hind steering-wheel might with great advantage be 22 inches diameter.

Hirst, of Croydon, is remodelling the machine, and I hope soon to hear that it is being manufactured for sale.

The tricycle I have just described was, of course, planned for speed only. Turning to another class of machines—those intended for carrying weights—I note that a really wonderful performance was achieved last week on one of Starley & Sutton's Coventry Chairs.

The rider of this machine left Coventry on the evening of June 19 at 6.30, carrying a lady in the invalid-chair strictly as a passenger, and fifty pounds of luggage. Daventry, a distance of twenty miles, was reached a little before 9.30—that is, in less than three hours. After some refreshment and a rest, a fresh start was made at 11 o'clock.

At 1.10 a.m. the rider and driver had reached the clock-tower at Towcester. Here rain began falling, and showers kept coming down throughout the rest of the ride, making the roads very heavy. The passenger, wrapped in waterproofs and carrying an umbrella, went to sleep, and allowed the umbrella to rest on the wheels, so that the driver had to wake her. Some time after this, when the rain ceased for awhile, the umbrella was dispensed with, and the lady in this interval slept undisturbed. This fact shows the easy motion of the Chair.

After passing Fenny-Stratford the driver encountered several miles of stiff, heavy ground of almost continuous hills. Dunstable was reached at 6.57 a.m., the pace having averaged six miles an hour all the way. At 9.30 a.m. the driver and passenger again started to run the last thirty miles into London.

The Finchley Post-office, 88 miles from Coventry, was reached at 3.15 p.m., and a telegram was despatched from there to Coventry. The driver then rode easily on to Euston-square, which was reached at 4.50 p.m., thus accomplishing a run of 95 miles in about 22 hours, including all stoppages.

The Coventry Chair would be invaluable at small railway stations for the conveyance of light luggage or a single passenger, and anyone having an invalid or crippled friend or relative would find one a boon beyond price.

A road ride has recently taken place between the rider of a tricycle and the rider of a bicycle.

Mr. Simmons, one of the best riders of the Waverley Bicycle Club, rode a light bicycle with a 57-in. wheel.

Mr. A. J. Wilson rode a regular roadster, Quadrant, made by Lloyd Bros. This machine had 40-in. driving wheels geared up to 60-in., and a steering-wheel 26 in. diameter.

The rider of the small-wheeled tricycle won easily, under this great disadvantage, that the road chosen being an exceptionally rough one, he could seldom find good surface for all three wheels, while the rider of the bicycle generally found a fairly good surface for two wheels in line, which requires good surface only for one.

The distance ridden was 22 miles, which was accomplished in 1 hour 37 minutes.

About two years since several riders wrote to Knowledge, ridiculing my notion that a tricycle with 40-in. wheels could be faster than one with 48-in. wheels; yet here we have a machine with two 40-in. driving-wheels beating a machine with one driving-wheel of 57 in. diameter.

Messrs. Lloyd have been the earliest after Humber & Co. to adopt small wheels. I notice more of their machines on the great South-road every month, and all their riders I have spoken to have been pleased with them.

Again, in describing the exhibits at the Stanley Show, I said that Starley & Sutton's Rover Safety Bicycle would prove to be the safest, and probably the fastest, machine of the kind among the great number exhibited.

I selected it for two reasons: Firstly, because the hind wheel was nearly as large as the front wheel; and secondly, because the rider was placed nearly midway between the two wheels.

Many experienced riders now find that it is nearly, if not quite, as fast as an ordinary bicycle on a level road, and faster uphill. It is, therefore, undoubtedly faster than an ordinary bicycle on an undulating road, and, on the score of safety, it leaves nothing to be desired.

The excursions of the Geologists' Association during July will be:—Saturday, 11th, Aldershot and Wellington College, leaving Waterloo at 10.15; Saturday, 18th, Ascot, Bracknell, and Wokingham, leaving Waterloo at 11; Saturday, 25th, Bedford, leaving St. Pancras at 11.10.

CHATS ON GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

THE SPHERE.

I.—Surface.

A. Of course we cannot deal with the sphere in the same way, seeing that it has no flat surface at all.

M. That is not the difficulty; for a hemisphere has a flat surface; and if you could deal with the hemisphere, you could deal equally well with the sphere.

A. The sphere seems likely to be difficult to deal with. In fact, I remember now that the discovery of the relation in volume between the sphere and the cylinder was considered so great a triumph of the geometrical skill of Archimedes, that it was especially commemorated on that great geometer's tomb.

M. Yes; but for all that there is no particular difficulty in the geometrical solution of this problem, once we have mastered the simple principle for the treatment of geometrical limits, already explained in this series of papers.

A. I cannot see how to set about it; there seems no place to begin from, whether we are considering the surface or the volume of the sphere.

M. Or in other words, you may begin *anywhere*.

A. Anywhere seems to me like nowhere in this case.

M. We will give the sphere a diameter, and start from that.

A. I suppose we begin with the surface?

M. We do. Suppose B A D, Fig. 1, a hemisphere; C, its centre; C A the radius perpendicular to the semicircle B C D, whose plane being turned edgewise appears as a straight line. Now observe that our proceedings are supposed to be tentative. I ask you, therefore,—what seems to you a natural way of trying to find the area of the hemisphere B A D?

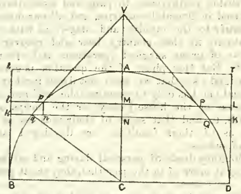


Fig. I.

A. Well, on the whole, I think I should begin by trying the effect of taking a number of equi-distant parallel planes square to the radius A C, and therefore parallel to the plane B C D.

M. You have made a very natural selection; and it will turn out fortunately; though had it not done so, that would have been no reason to be disheartened. In such cases as these we often have to make several trials before we hit upon the right method. We suppose, then, M N to be one of the divisions of A C, and p P, q Q planes taken through these points parallel to the plane B D.

A. What we want to determine then, at the moment, is the area of the strip of the sphere's surface lying between these planes.

M. Yes: and it is tolerably obvious that we shall not be far from the truth if we regard this strip as the surface of the frustum of a cone q V Q, obtained by drawing $q\,p$ V, Q P V, to meet on C A produced to V, and supposing the triangle Q N V to revolve round N V (after the manner described in Euclid's definition of a cone).

A. No: for M N is supposed to be exceedingly small, and the strip indefinitely narrow, so that we may regard $p\,q$ and P Q as to all intents and purposes straight lines.

M. Well, do you remember what is the curved area of such a frustum of a cone?

A. It is equal to the rectangle under $p\,q$ and the circumference of a circle having a radius midway between M p and N q; but of course the circumference of either circle p P or q Q would do equally well, since in the limit these circles are equal.

M. Thus then the curved area of our frustum $= 2\pi . q\,\mathrm{N} . p\,q$.

A. How does this help us? Both q N and $p\,q$ are variable, each changing with the change of the position of the element M N.

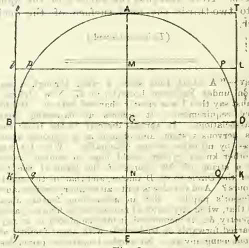


Fig. 2.

M. The obvious resource is to compare $p\,q$ with M N, and q N with B C. Maybe when we substitute what we thus obtain we may get a constant from the combination of two variables. Since you have to compare $p\,q$ with M N, it will clearly be well to draw $p\,n$ square to q N; also we had better join q C, so as to be able conveniently to compare q N with the radius of the sphere.

A. Let me see; $p\,q$ is to $p\,n$, or M N, as q V is to V N; and q N is to q C (or B C) as V N is to q V, the converse of the ratio just obtained. I see my way clearly now, for—

$$p\,q : \mathrm{M\,N} :: \mathrm{B\,C} : q\,\mathrm{N}$$

so that,

$$q\,\mathrm{N} . p\,\mathrm{Q} = \mathrm{B\,C} . \mathrm{M\,N},$$

a constant quantity.

M. The area of the strip of the sphere between p P and q Q is equal then to—what?

A. To 2π. B C . M N; that is to a cylindrical surface having the height M N and standing on the circular base B D. This of course is the same as the cylindrical surface obtained by completing the cylinder B t A T D on circular base B D and producing the planes p P, q Q to meet this cylinder in l, L, k, K.

M. You will see that this enables you to determine the whole area of the hemisphere. For, each strip of the sphere being equal to the corresponding strip of the enclosing cylinder, it follows that the curved surface of the cylinder t B D T is equal to the curved surface of the hemisphere B A D.

We have in fact this simple result:—If a sphere A B E D, Fig. 2, is enclosed within a cylinder t T Y y, the surface of sphere is equal to the curved surface of the cylinder. Also if any plane as $l\,p$ P L is taken parallel to the base of the enclosing cylinder, the curved area of the part p A P of the sphere is equal to the curved area of the cylinder t T L l.

A. Can we not thus compare the area of the sphere with that of one of its great circles?

M. We can very readily do so. For the curved area of the cylinder t T Y y is equal to the rectangle under the height and the circumference of the base $=2$ A C . 2π . B C$=4\pi$(B C)^2$=4$ times the surface of a great circle of the sphere.

A. So that if we divide A E into four equal parts in A M, M C, C N, N E, and draw l M L, B C D, k N K parallel to t T or y Y, the area of the sphere is divided into four equal parts, each equal to a great circle of the sphere.

M. Yes. Note also that the surface of the sphere is equal to two-thirds the total surface of the enclosing cylinder.

(To be continued.)

Memory.—"A short time since, I went through a course of instruction under Professor Loisette, at 37, New Oxford-street, and I must say that I was greatly charmed with it. It answered my every requirement. It ignores all harassing links and foreign associations. It appeals directly to the inner workings of man's nervous system, and obtains as a response a measure of success by no other means obtainable. Who, for example, by any other known system, could hope to commit to memory indelibly a string of 608 figures of the Ratio of the Circumference of the Circle to its Diameter, and that in the short space of two hours? And yet this is quite an ordinary performance with the Professor's pupils. But an astonishing feature about the matter is that, when any series of names, dates, figures, passages of prose or poetry, &c., is memorised, it may be picked up at any point and rehearsed forwards or backwards with equal facility, and all this without using any key. So simple, too, are the principles upon which the system is based, that they are capable of being mastered with the greatest ease by persons of all sorts and ages. So satisfied am I with the system as a means of scientific memory-training, that I am convinced that at some not very distant date it will form part of the curriculum at our schools. But of what use, it will be asked, is all this to telegraph clerks? Have they no need for improved and cultured memories? Are they so conversant with all that goes on around them, that when they get a sheet of almost undecipherable flimsy, they can call upon the natural memory to aid them? I think not—nay more, I am sure they are not. Nevertheless, were their memories once trained, an impression once made would endure for ever, and there would be no question of whether Mr. So-and-So or Mr. Somebody-else were member for such-and-such a place. Further than this, I am convinced that there is nothing which a telegraph clerk could study with better advantage, or with a prospect of securing a greater return for the outlay. A short time since a youngster walked into the Professor's room for a lesson, saying he had been trying for some months, so bad was his memory, to learn the Morse Code. The Professor had never before seen the alphabet; nevertheless, down sat the youngster beside him, brought out a copy of the code, and in thirty minutes had it as perfect as any member of the service. I may add that the Professor has introduced his method of learning Morse's Code, and also the Army Flag Signalling Code, into his new edition of his lessons, together with more than one thousand applications of his system, making his the most complete and exhaustive, as well as the most natural and effective, system of memory ever taught. This little incident may help to show how easy it is to educate the memory when once we set about it in rational and natural manner."—*From the "Telegraphist," June 1, 1885.*

LIFE IN DEATH.

By William Curran.

No one can have read extensively in any species of literature without coming across passages or occurrences, which must—at first sight, at least—appear to him to be incredible, if not absolutely impossible. Nor is this experience peculiar to works of fiction, in which it would, of course, be more excusable than elsewhere; it obtains also in the graver productions of the literary pen, and exaggeration rather than diminution is *the* characteristic of the *genus irritabile vatum* everywhere. Passing by, therefore, as being in a measure privileged, the "words that breathe, and the thoughts that burn" of the poet, we will descend into the lower plain of the historian, and endeavour to show that, so far as certain escapes or occurrences narrated by the latter are concerned, "truth is sometimes stranger than fiction."

Without stopping to discuss the differences that are produced in wounds inflicted by modern weapons and those that are due to the appliances used in former times, we may glance at the constitutional capacities for endurance, &c., that peculiarities of soil, climate, and food impress upon certain races, and so avoid technicality of all kinds. It is well known that man in the savage or semi-civilised condition has those organs of sight, hearing, touch, and the like, with which he has to contend for his support with the beasts that perish, more highly or sensitively developed than his brother of the city or the plains; and as an illustration of this, we may point to the fact, noticed in all the papers, that the Maories who lately visited this country always saw land before any of their fellow passengers. The savage man, *pur sang*, can sustain with impunity an amount of exposure and suffering that would certainly prove fatal to his more civilised brother, and the insensibility with which the American Indians, for instance, endure initiatory and other tribal tortures is simply astounding. A similar measure of imperturbable indifference to pain, and even death, has been noticed in Oriental countries, and all our doctors in India testify to the rapidity and *sang-froid* with which their patients in that country bear and recover from the effects of grave surgical operations and other like injuries.* But this phase of the question is generally acknowledged; so that we need not dwell further upon it here, and one has only to examine the calf-muscles of the *danseuse* or the horse-jockey, or the biceps of the blacksmith, to find that some of their muscles, as well, perhaps, as of their faculties, are developed at the expense of others.

That doughty deeds of personal daring and adventure were thought more of in the past than they are at present,

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* The following illustrative case in point is taken from Dr. Livingstone's "The Zambesi," p. 463, and appears to be otherwise worthy of reproduction in this connection. A native woman was, he says, when brought in, "found to have an arrow-head eight or ten inches long in her back, behind the ribs, and slanting up through the diaphragm and left lung towards the heart. She had been shot from behind while stooping. Air was coming out through the wound, and it was not deemed advisable to attempt any operation. One of her relatives, however, cut out the arrow and a part of the lung, and, strange to say, she not only became well, but stout." The late eminent military surgeon Guthrie used to say that wounds of the diaphragm never healed, but here is an instance to the contrary; and I have been told by a missionary, who saw the man, of a follower of King Mtesa who had been stabbed in the back, the spear penetrating near the scapula posteriorly and escaping through the chest in front *on the opposite side*, thus showing that both lungs had been ruptured. The hæmorrhage (which was, of course, frightful) was restrained by an infusion of hot coffee being poured into the wounds, and—he recovered.

may be at once admitted, and those hand-to-hand encounters we hear so much of in the pages of Gibbon and other writers are now rarely witnessed. Krupp guns and Martini-Henry rifles have so entirely revolutionised the art of war as to throw mere physical strength into the background, and place men, in the aggregate, on a level. Moreover, the atmosphere of the East has never been favourable to the enunciation of truth for truth's sake, and it was the interest as well as the desire of the Crusading writers to exaggerate the performances of their leaders and masters.

Nor need we go back to the Crusades for examples in point. They are to be found much nearer home, and deeds are ascribed, by serious writers, to some of our heroes in the East which would do no discredit to the prowess of a Cœur de Lion or even of a Saladin. Thus, describing some of the hand-to-hand encounters that took place at Meeanee, Sir Charles Napier is represented by his brother as saying ("The Conquest of Scinde," Part II., p. 320) that, "Fitzgerald's sword on its descent went shear through shield and turban and skull, down to the teeth," and Captain Creichton is said to have assured Swift (Works, Nimmo's Ed., p. 531) that, "Fowler (a Covenanter) aimed a blow at me, but I warded it off, and with a back stroke cut the upper part of his skull clean off from the nose upward." Dean Milman caps this narrative with an account he gives of the strength and skill of one, Ali, who, it appears ("The History of the Jews," Vol. II., p. 96), "Clove the skull of Marhāb, the great champion of the Jews (of Khaibor), through his buckler, two turbans, and a diamond which he wore in his helmet, till the sword stuck between his jaws," and whether the weapons used on these occasions were of Damascus or Toledo manufacture, we are unable to say. All we know is, that no such results follow from sabre blows or cuts in these our degenerate days.

So keen is the instinct of self-preservation, or the love of revenge, that men—aye, and women, too—have been known to achieve results under their influence which they would scarcely think of at any other time, or under any other impulse; and it is well-known that the excitement of battle and the hope of conquest have often enabled a handful of men to hold their own against overwhelming odds, and induced individuals amongst them to undertake enterprises that would in any other situation appear impossible. It is, doubtless, to these feelings that we owe some of the displays noted within; and the greater strength or ferocity of mountaineers is universally acknowledged. The two following stories will enforce and illustrate these points:—

Describing an encounter that took place in the reign of Robert III., between a body of Highlanders and a party of Lowlanders, Mr. Tytler says ("The History of Scotland," Vol. I., pp. 93-4), that "Lindsay had pinned* one of these 'mountaineers,' a brawny and powerful man, to the earth; but although mortally wounded, and in the agonies of death, he writhed himself up by main strength, and with the weapon in his body, struck Lindsay a desperate blow with his sword, which cut him through the stirrup and steel-boot into the bone, after which his assailant instantly sunk down and expired." And General Napier mentions a very similar struggle between a soldier of the 22nd Regiment and a Belooche swordsman. His account of it runs as follows ("*ut supra*," Part I., p. 317): "A soldier, bounding forwards, drove his bayonet into the breast of a Belooch. Instead of falling, however, the rugged warrior cast away his shield, and seizing the musket with his left hand, writhed his body forwards on the bayonet, until he could avenge himself with one sweep of his sword." He adds that a "Belooch requires no second stroke," and that "both fell dead together." Very tragic, no doubt, but—farther deponent saith not.

* Apropos of this "pinning," reference may be made to the case of the young Russian sailor, mentioned in almost all works on surgery, who, though pinned to the deck by a trysail-mast, which it penetrated, through his body, to the depth of an inch, yet recovered, and was able to resume his laborious employment. The writer may be here permitted to say that he has seen experiments tried on the "subject," &c., for the purpose of verifying or disproving these narratives, and that in no instance have the results corresponded with the effects said to be realised under the conditions narrated above. Victor Hugo mentions ("Histoire d'un Crime," p. 455), the case of "un ouvrier, percé d'outre en outre (qui), s'arracha du ventre la bayonnette et en poignarda un soldat."

We may quote the following from Scott, without in any way vouching for its probability in connection with this kind of mountain warfare, and leave the narrative to speak for itself. Describing the fierce and fatal struggle that took place in 1652 between Evan Cameron, of Lochiel, and an English officer of great strength, Sir Walter says ("Tales of a Grandfather," 1872, pp. 501-2) that "he (Lochiel) had a personal rencontre strongly characteristic of the ferocity of the times." Being singled out by the officer above referred to, and "as they were separated from the general strife, they fought in single combat for some time. Lochiel was dexterous enough to disarm the Englishman; but his gigantic adversary suddenly closed on him, and in the struggle both fell to the ground, the officer uppermost. He was in the act of grasping at his sword . . . . and was naturally extending his neck . . . . when the Highland chief, making a desperate effort, grasped his enemy by the collar, and, snatching with his teeth at the bare and outstretched throat, he seized it as a wild cat might have done, and kept his hold so fast as to tear out the windpipe. The officer died in this singular manner. Lochiel was so far from disowning or being ashamed of this mode of defence that he was afterwards heard to say it was the sweetest morsel he had ever tasted."

(To be continued.)

THOUGHT AND LANGUAGE.

BY ADA S. BALLIN.

XII.

To give a detailed account of the signs which make up the natural gesture language would be a gigantic undertaking; but in order to show how these word-pictures are composed, I may here cite a few of the more complicated expressions used by deaf mutes. Thus, the sign for *wet* is to wet the right forefinger with saliva; and to express *flowing* this action is combined with an illustration by both hands of the wave-like action of water. For *stone* the sign for *hard* (striking the knuckles) is combined with the act of throwing, while for *building stone*, in addition to the preceding gestures, the hands are laid several times one over the other. *Precious stone* is represented by stone, colour, and the action of counting out money into the left hand to show the value of it. For *hospital* the signs are those for *house* and *ill*—a similar combination to the German *krankenhaus*. For *horse* the apparent height of the animal is shown, then the index and middle fingers of the right hand are straddled over the index of the left, to show that it is used for riding, after which the right foot

is stamped on the ground, as when the animal is impatient.

As may easily be imagined, the gesture language has no more inflections than the Chinese, and the same sign stands for *walk*, *walker*, *walking*, *walked*, *walkest*, &c., hence, theoretically, the various parts of speech may be supposed to be not easily distinguishable, but this is rarely the case, as words or signs are understood by the context. The deaf mute arranges his sentences somewhat after the manner of the Latins, always putting first the word which he considers the most important. Thus, the sentence "I should die of starvation if I had no food," would be "Food (imitation of eating)—no (shake of head)—I (point to self)—dead (relaxation of muscles and leaning back with eyes closed). Questions are asked by the deaf mute by means of inquiring glances, as: Have you any bread? would be "Bread (imitation of act of cutting it)—you (pointing to the person addressed)—and a look of interrogation. That we ourselves ask questions in this way by facial expressions is a matter of everyday experience.

Dr. Steinthal has said that the verbs "to have, to be, to be able, and similar signs, are wanting to the natural sign-language of the deaf and dumb, and, he adds, without the help of these abstract signs, the whole play of ideas is obscure;" but, although a great authority on the subject, Dr. Steinthal is wrong in the present instance. Of course, as above remarked, there is no regular conjugation of the verb; but none the less does it exist for practical purposes. If asked, "Can you?" or "Will you do so and so?" the deaf mute answers with a nod or a shake of the head, "I can" or "I won't." When he wishes to be more emphatic, emotional expressions come into play. If he wishes to say "I *will* fight," he rolls his fists with a look of much meaning, not likely to be mistaken. To prefer the request "*May* I go out?" he points out of doors with a look of entreaty. The imperative with *shall* and *must* are expressed by volitional gestures. To *have*, the subject is pointed at with a nod of affirmation, or a shake of the head in case of negation. Thus, "I have eaten," I (point to self) eat (act of eating), yes (nod). "He has the meat," he (point to him, or, if absent, describe characteristic mark, as the man with a long beard) meat (pinch up flesh on back of hand), yes (nod). All the signs hitherto mentioned are natural signs common to all, but there is a very widespread sign for "done," "already," &c., which is apparently conventional: this is to strike the outside of the right hand on the flat palm of the left, as in the action used to signify cutting bread, but without the sawing movement, hence it seems to mean "cut off," "finished with." This sign is generally used for the past tense, as "I—cry—done," for "I cried." If a boy were to point first to himself, then to another boy, make the action of biting, place his hand at the level of his knee, and make the sign above described, I should put it into words as follows, "When I was as high as my knee I bit him."

There is an inherent logic in this gesture-language, for while our words are conventional and require to be defined to those who do not understand them, *its* words are in themselves definitions. Thus spring is the beautiful time when the sun is warm, the ice and the snow have gone, and the flowers and grass come. *Rain* is the *wet* that falls from the sky; the dumb child wets the tips of his forefingers, and makes a movement from above downwards with both hands. The Turk is the man that wears a turban.

Uneducated deaf-and-dumb children, being cut off from participation in the more complex thoughts of others, are, as already said, limited in their ideas to their own experience of men and things, like ordinary children who have not been taught better, and, like savages, they attribute to things they do not understand causes and characteristics most analogous to their previous experience. They are at the myth-making stage. For them the stars are candles in the sky, and the horizon is a dome which touches the ground, and they long to reach it and climb into the sky. One big boy, who had probably seen his mother making bread, told me that before he learnt on the oral system he used to think his mother made his little brothers and sisters out of flour; and another said he thought she bought the baby from a shop. They think rain is caused by somebody pouring water out of a water-can, an idea in which they agree with the ancients, who believed in Jupiter Pluvius. From all this it may easily be imagined that the deaf and dumb possess few, if any, abstract ideas. Thus their ideas of space and time are very crude. Their ideas of time are marked by their physical experiences: *mid-day* is when they eat with spoons, knives, and forks; night is when it is dark and they go to sleep. The *past*, by a mode of thought similar to that expressed in our own word, is what they have *passed by*, while the future is what they will come to. Thus the dumb person expresses *present* by "here," *past* by "behind me," and *future* by "in front of me." Yesterday before I slept once. For *the day before yesterday* he puts two fingers over his shoulder. But he gains other simple abstract ideas from his own observations, and communicates them accordingly, thus:—To mean *everyone*, he describes with both arms as large a circle as he can in the air; while for *many*, he holds up his ten fingers over and over again with a look of astonishment. To indicate *shame*, he points to himself, then to his lips (red), and afterwards to his cheeks, and turns his lowered head from the person with whom he is conversing, making up a pictorial representation of the facial expression which accompanies shame.

The deaf and dumb in like manner soon get ideas of propriety. A boy visiting a deaf and dumb school indicated the word *black* by pointing to his dirty fingernails, an action which drew from the children the comment that his language was ugly, and disgusted them extremely. From their experience of life they gather also ideas of the value of truth. Thus, a dumb person, when talking of a *lie*, makes an action as if speaking, and moves his hand downwards with an expression of contempt, while for *to speak truth* the action of speaking is imitated, and the hand laid on the heart. This action used to imply *truth* is, of course, an indication of *belief*, and a curious analogy may be drawn between it and our word *creed*. Creed is derived from the Latin *credere*, to believe, which is itself a compound of *cor*(*d*), Greek *kardia*, our *heart*, and the root *dha*, to place; compare Sanscrit '*srad-dadhâmi*. So that to believe is to feel at heart; to speak truth is to speak from or with the heart.

An interesting point in the growth of the deaf mute's sign language is that since his signs are derived from aspects of things, he is liable to choose as characteristic signs of a class, properties which that class possesses in common with other classes hitherto unknown to him. Thus, he soon finds some of his expressions to be too general. For example, he has named the goat from its property of *butting;* but he afterwards finds that other animals also butt with their horns, then he specialises by adding some other attribute, and signifies goat as the *butter with a beard*. After using the general sign of *drinking* to mean *water*, he discovers that other liquids,

such as beer and wine, are drunk, and then water becomes for him the liquid that is *drunk*, and also used for *washing*. In a similar way the ordinary child learning to speak, uses words in a more general sense than that in which they are used by his teacher. A baby who has learnt the word *papa* does not use it to signify his own father only, but applies it to all men, and I believe that the reason of this is that he has associated the word *papa* with certain characteristics, such as the wearing of trousers, &c., the possession of a deep voice, and having hair on the face. Thus the word means to him certain aspects which many have in common; he does not distinguish at first the special characteristics which mark off his father as an individual from all other individuals. The lower we go in intellect the greater is the tendency to see likenesses to the exclusion of differences. This is eqnally so with the young child and the savage. Thus a young language is chiefly figurative. But as the mind, by increased experience and the logical development brought about by this, becomes more analytical, differences are attended to in the degree that they merit; and the likenesses which formerly found expression are apt to be overlooked, and even the origin of the words to which they gave rise forgotten. Who at first sight would imagine that *creed* in its etymological meaning is a *something given from the heart*. Professor Sayce has beautifully expressed this tendency in the words, "Language is the treasure-house of worn-out similies—a living testimony to the instinct of man to find likeness and resemblance in all he sees."

Mr. H. R. Goodwin, of the North Manchester B.C., has recently completed perhaps the most remarkable ride ever yet accomplished on the bicycle. Leaving Land's End on June 1, he rode to John o' Groats; having reached which point in seven and a half days, he at once turned southward, and arrived again at Land's End on the 16th, having completed the double journey from one extremity of England to the other, or about 1,800 miles, in less than sixteen days. From Land's End Mr. Goodwin rode to London, where he arrived on the 19th, the total distance ridden being 2,050 miles, in exactly nineteen days, or an average of about 108 miles per day. He rode a 40 in. "Facile," which carried him well from start to finish, and he arrived in London fresh and well.

The London Stereoscopic and Photographic Company, Limited.—For many years this well-known photographic business has existed as a "Company"—in the ordinary acceptation of the word—in name only. It has latterly been pretty generally understood that the enterprise was a proprietary one, carried on by the late Lord Mayor, with the assistance of his son, Mr. Charles G. Nottage, Mr. Howard Kennard also being a partner. The recent death of the first-named gentleman, however, has induced the surviving partners to convert the business into a "Company," in the fullest financial sense, and a prospectus (which appears in another part of this number) has been issued, setting forth that the required capital is £90,000, to be realised by the issue of 18,000 shares of £5 each. We are not particularly concerned with the financial aspect of the question, but, considering the growing increase in the numbers of amateur photographers, and the fact that the business of the proposed Company would largely consist in supplying their wants, it would seem to be a speculation sufficiently sound from an investor's point of view, and one offering to the amateurs before-mentioned the opportunity of forming themselves, as shareholders, into a self-supply association on advantageous terms. The vendors are reliant as to the immediate success of the undertaking; and although promoters are often over-sanguine in prospectuses, yet in this case the reliance is justified, inasmuch as the profits of the business are actually existent, not merely estimated. The vendors take a third of the purchase-money in shares, and agree to accept no remuneration for their services as directors until 7 per cent. has been paid to ordinary shareholders; this, at any rate, testifies to their own faith in the successful working of the Company. But, as we have before said, we have no concern here with questions of purely financial interest, and call attention to this matter in these pages only because we knowingly include amongst our readers a large number of amateur photographers, who may be specially interested, and pleased to have their attention directed to the prospectus alluded to.

FIRST STAR LESSONS.

By Richard A. Proctor.

The constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct) :—

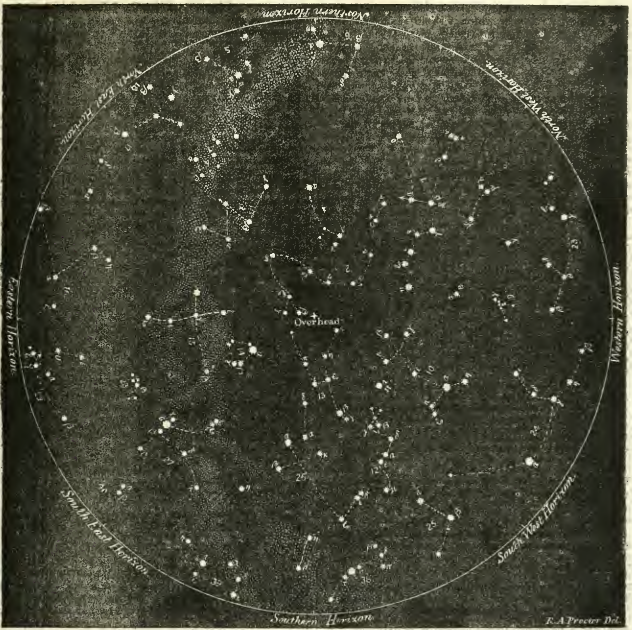
1. *Ursa Minor*, the *Little Bear* (*α*, the *Pole Star*).
2. *Draco*, the *Dragon* (*α*, *Thuban*).
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*α*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*α*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*α*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*α*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*α*, *Vega*).
15. *Cygnus*, the *Swan* (*α*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*α*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*α*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*α*, *Regulus*).
24. *Virgo*, the *Virgin* (*α*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*α*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*ο*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*α*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*α*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*ι*, *Alphard*).
36. *Crater*, the *Cup* (*α*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*α*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*α*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*α*, *Sirius*).
45. *Argo*, the *Ship*.

Gossip.

By Richard A. Proctor.

I have read letter 1,740, by "Commentator," with intense pain—chiefly because it was my own action in forwarding an extract from the *New York Tribune* which elicited "Commentator's" ill-judged remarks. I cannot understand how anyone can imagine that the expression of an opinion, no matter how far that opinion may differ from his or her own, can justify personal objurgation in any form. "Commentator" would not, I presume, have ventured to say to George Eliot herself what he (or she) has unfortunately been allowed to say in these columns. At least, I hope not, for his (or her) own sake. What opinion was formed by all whose opinion was best worth considering, "Commentator" knows. It is a matter of small moment that George Eliot was honoured by the conventionally noblest in the land, from the Queen downwards (conventionally) — it is more important to note that she was esteemed by the wisest and the best. Her philosophy was kindly, gentle, and honest. Less original than most readers of her works imagined, she had learned in the best schools; and she taught more effectively than those from whom she had in reality derived the larger portion of her doctrine.

Of the relations between George Lewes and George Eliot it becomes none to judge, unless it can be shown



NIGHT SKY FOR JULY (FIRST MAP OF PAIR),

Showing the heavens as they appear at the following hours:—

July 3 at 10¼ o'clock.	July 11 at 9¾ o'clock.	July 18 at 9¼ o'clock.
July 7 at 10 o'clock.	July 14 at 9½ o'clock.	July 22 at 9 o'clock.

that any one was personally wronged in the matter. Even then judgment by an outsider would be improper. A teacher, whom "Commentator" appears to accept, has expressed very strong condemnation of such judgments as his (or hers). The manner in which "Commentator" views the matter, is, however, too outrageous to be harmful, save to himself (or herself). Even those who most regretted George Eliot's decision, even those who in her lifetime openly condemned her conduct in this matter, applied no such epithet, directly or indirectly, as "Commentator" with amazing fatuity has attempted to fasten on her. One might as well apply such a term to a second wife who was a sister of the first, because the law pronounces such a marriage illegal. To all intents and purposes, save as regards the letter of the law, George Eliot was George Lewes's wife. The relation contemplated in marriage has seldom—perhaps never—been more beautifully fulfilled. The law would have made Mr. Lewes a criminal had the legal ceremony been performed, whether by priest or magistrate; and to persons with the opinions (I may say the faith) of George Lewes and George Eliot the legal ceremony would have had no intrinsic value. The only point they had to consider was whether the tie was binding on each, and whether each could trust the other to regard it as such. No one who knew either, certainly no one who under-

stands the meaning of George Eliot's life, can doubt that they were united by a tie which was to them perfectly sacred. Whether, the world being what it is,—most easily offended where it offends most readily—George Eliot and George Lewes should have sacrificed themselves rather than offend the worse minded (I mean most literally *sacrifice* themselves, because they would have sacrificed the better part of their life work, of what the world now owes to them) is another matter. It would not have been just to have so sacrificed themselves, though it might justly have been regarded as sublime.

But would the world—meaning its worse part—have understood them if they had done so? I think not. The world would have judged and condemned them more foully than it has condemned them already.

There is a case in point. I will not mention names; I can hardly touch on facts; yet the facts are well known to a few. In the case I have in my thoughts, the woman is married, and has suffered grievous wrong. The sacrifice which the world's worse part (making no sacrifices itself in such things) would have claimed from George Eliot and George Lewes has been made by this woman and the man, who loves her as his life, and esteems her as the bravest of her sex. Thus have two lives been embittered. Has the world's worse part understood—*nay*, but neither name of these two can be mentioned, before all but a few who know, and a few more who can understand goodness, without the foulest abuse from those who only know and only really understand that they themselves are incapable of self-sacrifice in such matters,—or even of self-sacrifice in what, to persons of the class to which George Eliot belonged, is not held worthy of a thought.

That George Eliot "anonymously preached per Dinah, while she utterly disbelieved Dinah's rhetoric," is a roundabout and ill-worded saying scarce worth answering. As a matter of fact, George Eliot pictured a Methodist of the best type preaching as such a person would. I apprehend, moreover, that with the essence of what Dinah taught George Eliot was perfectly in sympathy. George Eliot's life was beautiful, in its tender kindliness, and her philosophy was as gracious and loving as it was wise.

I observe that my friend the Editor considers he has *seen* lightning-flashes passing from the ground to the storm-cloud. His words are that "*pace* Professor Tait," he has "distinctly seen lightning strike *upwards*." Professor Tait did, I know, assert this to be impossible, in a lecture in which he was good enough to reproduce my own reasoning (in an article on "Electric Lighting," published in the *Cornhill Magazine* a few months before) not only on this point, but on the actual brightness of the electric flash, and some other points respecting which I had presented some rather novel points. I was particularly struck by this because, shortly before, he had criticised a work of mine in that back-stabbing manner for which he first acquired renown in Professor Tyndall's case. The point of this stiletto method consists in avoiding anything like direct correction or any statement as to why, where, or how, particular passages may be erroneous, the crafty critic simply quotes such passages with the remark, If *this* is right, I am all wrong, the innocent reader imagining this last alternative to be impossible or it would not be suggested. Another way is to quote a passage and exclaim, "These be thy Gods, O Israel," or the like, leaving the reader to suppose—incorrectly—that there is something very wrong.

With all respect for my friend the Editor's keenness of observation, and (I need hardly say) the most perfect reliance on his account as presenting what he thought he saw, I venture to say that no human being can really see whether a lightning-flash goes one way or the other. I would invite the Editor to consider the evidence derivable from what is called "personality" in transit observations. We know, by comparing the work of different observers that *no* observer can be trusted to tell within the tenth of a second, *surely*, the instant when a "wire" (so called) reaches a star, *i.e.*, no one can tell whether at the particular instant when the wire actually does reach the star, it has really reached it, or has already passed it, or is short of it, by one-tenth of a second's apparent motion of that star. Now let us see what an observer really claims to do when he undertakes to decide whether the earth end or the cloud end of a flash appeared first. Suppose the flash to be fifteen miles long, which for a flash whose whole course is visible is a goodly allowance. Then it is known that the flash takes less than the 10,000th part of a second in traversing that distance, whether it passes from cloud to earth or from earth to cloud or both ways simultaneously. Actual timing of the duration of the light indicates a much shorter time, usually, even than this, (it is well known that Talbot photographed fine printing on a rapidly whirling wheel, illuminated by an electric flash, so minute was the change in the position of the wheel's rim while the light lasted). In claiming, then, to know which way an ordinary lightning-flash travelled, the observer claims a keenness of perception *more than a thousand times greater* than that of our most experienced astronomical observers. All that has really happened when a lightning flash has been *seen* to strike upwards, has been that the observer has chanced to be looking towards the earth when the flash appeared, so that he has been first conscious of the appearance of the earth-end of the flash.

I have not been content to let this be a mere theory, though I take it the reasoning, rightly understood, is convincing. I have tested the matter repeatedly. Let several observers (a family of them will do) watch the progress of a thunderstorm. (In America, where I am now writing, the opportunities are almost too good, thunderstorms being very frequent, and in many of them the lightning flashing continuously.) Let half the observers direct their attention to the storm-cloud or clouds, the other half to the horizon. It will be found that the self-same flash will be *distinctly seen* by one set to strike *downwards*, while by the other half it will be as distinctly seen to strike upwards. In like manner the self-same horizontal flash will be distinctly seen to pass from right to left, and as distinctly seen to pass from left to right, according to the way in which the observer chances to be looking at the instant.

Col. Tupman, commenting at the Astronomical Society, on my theory that meteors and comets were originally projected from the interior of suns or of planets in the sunlike state,—a theory advanced thirteen years ago before Mr. Denning had discovered meteors of long-lasting radiants, moving therefore with immense rapidity—argued that the theory is contradicted by the circumstance that the average velocity of meteors is

that due to parabolic orbits. That was the belief of astronomers when my theory was first published and till Mr. Denning made his important discovery. All I did in the paper on which Col. Tupman supposed he was commenting, was to show that my theory accounted for the enormous velocities which Mr. Denning's discovery absolutely demonstrates, if accepted—and Colonel Tupman it was who first maintained that it must be accepted, being established by incontrovertible evidence. The argument, then, stands thus: I advance a certain theory about meteors and comets, when as yet moderate velocities only had been observed; Colonel Tupman brings before the Astronomical Society decisive evidence of enormously greater velocities; I show that my theory will account for them (which no other theory *will* do); he replies (?) "the theory cannot be sound, for no such velocities exist!" It seemed to me as though a more marvellous bull had scarcely ever been managed.

Reviews.

SOME BOOKS ON OUR TABLE.

Text-book of Structural and Physiological Botany. By Otto W. Thomé and Alfred W. Bennett. Fifth edition. (London: Longmans, Green, & Co. 1885.)—Whether we regard this as a text-book for the student, or as a hand-book of reference for the advanced botanist, it really seems as though it would be difficult to improve upon it. In fact, the mere mention of the appearance of five editions of Professor Thomé's work in its English dress in eight years will suffice to show how thoroughly it has filled something approaching to an absolute void in its own department of botanical literature, and how valuable it has been found by the numerous class which it addresses. And assuredly its success has been deserved, inasmuch as it is devoid of "cram" in any sense, and is educational in the highest. The histology, external form, structure, morphology, and classification of plants are successively treated in detail. Their pedigree, so to speak, is traced from the dim indications of Algæ in the Silurian rocks, down to the vegetation of to-day. A chapter on botanical geography exhibits in succession the leading botanical features of all the known parts of the earth, while a first-rate glossarial index completes the volume, which is further illustrated by something like 600 woodcuts and a coloured map. We may pretty confidently assume that this fifth edition will be very far indeed from being the last one.

The Nomenclature of Diseases. Drawn up by A Joint Committee Appointed by the Royal College of Physicians of London. 2nd Edition, being the first revision. (London: Harrison & Sons. 1885.)—"In order," says J. S. Mill, in his "Logic" (Book IV., Chapter 4), "that we may possess a language perfectly suitable for the investigation and expression of general truths, there are two principal, and several minor, requisites. The first is that every general name should have a meaning, steadily fixed and precisely determined;" and assuredly it is essential that the name of any given disease and all that such name connotes should be of the most definite possible character. Of course, without some generally-recognised nomenclature of Diseases, statistics worthy of the name in connection with them become impossible; and on the value of trustworthy statistics of disease extending over a sufficiently wide area, it is wholly needless to insist here. But the difficulty or impossibility of tabulating such records (save in a limited and imperfect manner) where three or four different names are employed to designate the same complaint must be apparent at once; and hence the necessity for an authoritative and admitted nomenclature. As far as our examination has extended, the Committee seem to have done their work ably and conscientiously; the sole slip—and that is in all probability a printer's error—that we have detected occurring on p. 135, where "spasomdic" occurs for "spasmodic." A notable and valuable feature in the book is the furnishing of the Latin, French, German, and Italian synonyms of every disease comprised in the list. As a matter of course, every physician and surgeon in the United Kingdom will provide himself with this indispensable book, which, it is to be hoped, in the interest of science will obtain a large Continental circulation too.

How to Draw a Map from Memory. By P. E. Swinstead, B.A. (London). (London: Simpkin, Marshall, & Co.)—We are a little afraid that Mr. Swinstead gives his readers credit for the possession of a particular kind of memory which is by no means common among students. He employs a novel and remarkable system of co-ordinates, consisting of straight lines and more or less complex curves, the *ensemble* of which has all to be remembered. These co-ordinates are printed in red, and the outlines following them are subsequently drawn in black. It may be the novelty of the idea, or, of course, our own stupidity, but it seems to us that the outline of Europe or Africa could be fixed in the mind in considerably less time than the complicated, and seemingly meaningless, pieces of geometrical construction which are to form its substratum.

Denudation of the Two Americas. By T. Mellard Reade, C.E., &c. (Liverpool: C. Tinling & Co. 1885.)—This is a reprint of Mr. Mellard Reade's Presidential Address to the Liverpool Geological Society, and essays to make a quantitative determination (at all events, approximately) of the amount of solid matter annually removed from the continents of the New World by various forms of denudation. Mr. Reade insists, as we think justifiably, on the importance of chemical action as a denuding agent.

Pattern-Making. By a Foreman Pattern-maker. (London: Crosby Lockwood & Co. 1885.)—Articles, be they large or small, from the framing of a Nasmyth hammer to the cylinder of the toy steam-engine, which are made in cast-iron or brass, are "cast," that is to say are formed by running the metal of which they are composed in a liquid form, into a mould of the size and shape of the object to be produced, such mould taking the form of a hollow or depression in a tightly rammed mass of peculiar sand known as moulding-sand. But obviously, in order to form such a mould, an original pattern of the article to be cast must be made; and the construction of some of these patterns often presents extraordinary examples of ingenuity. The work before us is of an eminently practical character, and gives the most detailed instructions for the production of the patterns of the component parts of every type of mechanism which are formed by casting. No book with which we are acquainted goes into such minute details on this subject as the volume on our table; in fact, it supplies the apprentice or beginner with a complete course of instruction in his art. Much of the work has seemingly appeared in a detached form in the columns of our contemporary, the *English Mechanic.* In the interests of mechanical art, it is to be hoped that its readers in its book form will be as numerous as they

must have been in its serial shape. It is an honest and thoroughly trustworthy work.

The Phainomena, or Heavenly Display of Aratos. Done nto English verse by ROBERT BROWN, JUN., F.S.A. (London: Longmans, Green, & Co. 1885.)—Yet another translation of the φαινόμενα of Aratus! This time seemingly to support the theory of the origin of the constellations, very ably maintained in former works by the same author; in fact, the notes, which exhibit a large amount of learning and research, afford the justification for adding one more to the pretty numerous versions of Aratus which have appeared. A considerable number of reproductions of very quaint old engravings, and a map of equatorial stars for the Equinox, B.C. 2084 illustrate the text and notes of Mr. Brown's volume, which should commend itself to all for whom the earliest record of our existing constellations possesses any interest.

Singing in Schools. A Complete Course of Practical Teaching. By ALFRED B. HASKINS. (London: Bemrose & Sons. 1885.)—On the value of singing as an innocent and delightful recreation it would be merely idle to insist; and that it should form part of the school-course of every child with the slightest approach to the possession of "an ear," seems in every respect desirable. And, certainly, if music is to be taught in our public elementary schools, it would not be easy to find a better or more thoroughly sensible and practical manual than Mr. Haskins has given us. His book furnishes abundant internal evidence of the possession on the part of its author of a sound and competent knowledge of his subject, and—what is by no means invariably associated with such knowledge—the faculty of lucidly imparting it. We hope that his work will meet with the success which it undoubtedly deserves.

The Studio, and What to Do In It. By H. P. ROBINSON. (London: Piper & Carter. 1885.)—Primarily addressed to the professional photographer, Mr. Robinson's capital little book may be read profitably and advantageously by every amateur who has ever tried, or who ever proposes to try, to take a portrait. Few of our living writers have done as much as Mr. Robinson to forward the growth of artistic taste in photography, and to render the photograph really a thing of beauty, and not a mere hard, dry, mechanical reproduction of the object depicted. He sustains his well-earned reputation in the present small volume.

Crowded Out; or, Not Hung for Want of Space at the Royal Academy, 1885. Edited by HENRY LASSALLE. (London: Sampson Low & Co. 1885.)—Mr. Lassalle has done a real service to art in the publication of the work whose title heads this notice. By the aid of something like a hundred *fac-simile* sketches drawn by the artist's own hands, of pictures rejected at the Royal Academy, the reader is furnished with the means of contrasting the obvious artistic excellence of some of the paintings which failed to gain admission, with the mass of mediocrity (to say nothing of downright rubbish in places) which appears upon the walls.

The Moon's Rotation, examined by the Newtonian Theory of Gravitation. By THOS. F. TYERMAN. (Oxford: Slatter & Rose. 1885.)—Into Mr. Tyerman's teleological argument we absolutely refuse to enter. Whatever it may be worth (and we have a very definite opinion of its value), it is not Science. His hypothesis of the cause of the coincidence in time of the moon's motions of revolution round the earth and rotation on her own axis may be briefly epitomised by saying that he considers that the gravitating force of the two hemispheres of the earth and her satellite which are facing each other, must act as though producing temporary cohesion; and that, so to speak, the outside hemisphere of the moon being affected by no such force, must tend to go in the direction of the moon's motion of translation, and so turn her round. The proximity of the earth and moon, and the comparatively small difference in their sizes, seem to be advanced as one reason why the quasi-cohesion should exist; but these conditions assuredly do not obtain in the case of Jupiter and his four satellites, or in that of Saturn and Iapetus, in both of which cases we have evidence of the coincidence of their times of rotation and revolution. Nay, were Mr. Tyerman's theory true, there is nothing to prevent its application to the sun and earth. We can only regard his book as an example of misapplied ingenuity.

Blackie's Elementary Text-books. Botany. By V. T. MURCHÉ. *Magnetism and Electricity.* By W. G. BAKER. *Elementary Algebra.* (London: Blackie & Son.)—These text-books, compiled to meet the requirements of the Educational Code, are really well done, and, if intelligently studied, are calculated to impart no inconsiderable amount of rudimentary information. They ought to be useful at once to the teacher and the pupil.

Algebraic Factors. By W. T. KNIGHT, F.S.Sc. (London: Blackie & Sons.)—This little book follows something on the lines of that by Mr. Easton, which we reviewed on p. 56 of our last volume. It will be found useful by the beginner.

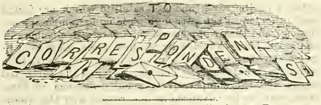
Studies in Microscopical Science. Edited by ARTHUR C. COLE, F.R.M.S. (London: Baillière, Tindall, & Cox.)—The usual monthly issue of this excellent work worthily sustains its reputation.

The Imperial Review. April, 1885. (Melbourne.)—This quarterly review, which reaches us from the Antipodes, is of a lighter and chattier character altogether than its English prototypes, containing as it does no less than thirty-eight articles within the compass of 80 pages. What we may term the local element in the essays of which it is made up is conspicuous, if not by its absolute absence, at least by its paucity; the most diverse subjects—literary, social, historical, and political—finding a place or places in its pages. It is very readable.

The Science of Sanitation. By B. SHARP & Co. (London: The Authors'.)—Those who are suffering from the evil sanitary arrangements but too frequently found in our dwelling-houses, may learn from this little pamphlet, the character and sources of the danger to which they are exposed, and the means of rendering their residences pure and healthy.

Cassell's Readable Readers. Third Reading Book for Standard III.; Fourth Reading Book for Standard IV. (London: Cassell & Co.)—If reading does not become a pleasure instead of a toil with the boys and girls who have to use the two books before us, it will not be the publishers' fault. The selections are interesting, amusing, and instructive, and the very numerous illustrations good and apropos, some of the vignettes being really beautiful. This series will surely be popular.

We have also on our table *The American Naturalist, The Sanitary News, The American Druggist, Wheeling, The Tricyclist, The Journal of the Society of Arts, The Medical Press and Circular, Proceedings of the Geological Society, Report of the Association for the Oral Instruction of the Deaf and Dumb, Naturen, Ciel et Terre, C. Hutt's Catalogue of Scarce Books, Electricité, Bradstreet's.*



"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THE GREAT SUN-SPOT.

[1798]—I must apologise for troubling you again, but the magnificent display of solar activity shown in this splendid group is worthy of notice in KNOWLEDGE.

June 20, 8 a.m. Aperture, 3½ in. Wray; power 220; screen definition good.

Appearing on the limb on the 15th, unfavourable weather has prevented us from seeing it again until to-day (June 20).

Certainly we have had nothing like it as a display of force since 1883. The leading spot measures about 1′ 15″ on the disc, while the group in extreme length is about 3′ 40″.

Observing it with a direct eye-piece, the sight is really fine. The whole seems connected, and one common movement appears to pervade the different masses. At times of superior definition a great part of the penumbra seemed honeycombed with dark markings. I enclose a correct copy of a careful drawing done at the screen.

G. L. BROWN.

THE OLDEST SOLAR MYTH.

[1799]—In letter (1779) I said I believed the flaming sword of Eden to be a tradition of a real occurrence. If any curiosity be felt, I will explain.

In 1880 I wrote an essay (unpublished) arguing that the real Eden must have been at the north pole; at the pole, because the globe would there first be cool enough for life; at the north, because in the south pole's summer the earth is in perihelion*, so that it would remain hot after the north one. It has been replied that in those very remote times other conditions obtained, owing to the different ellipticity of our orbit; but a letter in *K.* last spring shewed that no trustworthy calculations exist as to this, since the discovery of Neptune vitiated all the previous ones.† I think two things may lead to conclude that the north pole was the first; (a) the fact that Torres Straits divide the southern from the northern fauna, as if the northern had had a longer run; (b) that man has become most civilised north of the equator.

Three or four books have since advanced this theory; one was noticed in *K*, but I have not seen any of them.

If the hypothesis is admitted, it is clear that life began, and continued for very long, under conditions wholly different from any with which we are familiar, or indeed which exist on earth now. All living things must have been confined to a roughly circular patch round the pole, widening as the earth cooled. The heavenly bodies were entirely invisible; a dense cap of cloud hung over the world, containing great part of our actual oceans. There would be a constant hot wind from the south. In fact, a Russian bath must have been our primeval climate. During the six months' day there was a dim light, equal perhaps to that of a London station in a fog. During the six months' night there would be impenetrable darkness, except perhaps for a few days before and after full moon.

Are there any data whence we can guess whether man already existed under those conditions? I think there are.

1. It seems improbable that man would hybernate, with his active brain. Darkness alone would not cause him to do so, for the mole, who lives always in the dark, is obliged to get up every four hours and make a hearty meal, otherwise he would die of starvation. But if man did stir at all during his long night, he would certainly be most alive and active for all objects at the four or five half-light periods of, say, eight days about the full moon. May not this be a more probable origin for certain periodical animal functions than the only one Darwin could imagine? viz., the covering of an ascidian at spring-tides (which would surely rather tend to establish a *fortnightly* period?) And this excitement by salt-water would not account for its absence in the intermediate phases of development. A definite period once established would not coincide with the *full* moon in every individual; any more than diurnal periods, as to which, *e.g.*, we see all men eat every day, but not all in appetite at the same hour. The full moon, however, does more or less trouble both men and other living things—*e.g.*, dogs—in a greater degree than the mere light explains. In Central America there are individuals who are "no good" except on moonlight nights, exceeding, then, in aptitude for the chase, &c., all others' *daylight* doings.

2. There is a universal tradition of a golden age—"*Saturnia*

* At present; 12,000 years ago precisely the opposite condition of things obtained.—ED.

† This must be taken *cum magno grano salis.*—ED.

regna"—when things were wholly different. Given that man started from a savage state, how can this be accounted for, if his conditions were the same as with savages now?

3. When the present state of things were about, the earth would be found less fertile, and life harder. The cloud-cap gone, and the easy Paradise gone, for the first time men saw the sun. It must have no doubt hurt their eyes very much at first. What more likely explanation than this for the flaming sword which *turned every way*—as the solar beams do—and was at the *east* end of the garden—where the sun rises? The record seems a strange one, if it cannot be explained naturally; for it would have seemed more natural to a primitive narrator to set lions or other beasts to guard the forbidden ground; which *we* know is not on earth at all.

Space forbids to pursue this theme further; but I suggest that physicists, if they keep it in mind, may perchance find it explain facts in natural history hitherto obscure. Hallyards.

THE MATHEMATICAL THEORY OF EVOLUTION.

[1800]—"Commentator," in referring to my theory of evolution, has unfortunately quoted a misprint from the brief extract given of it, under the above heading (p. 486)—*proposition* should have been printed proportion. The editor will therefore perhaps kindly allow me to restate the several positions, and to allow the printer to use capital letters and italics where I have used them:—

1.—*Adaptation to Purpose, Fitness,* resolves itself into *Adaptation of Proportion to Purpose.*

2.—*Evolution, Development,* into *The Becoming of the Proportioned in All Things.*

3.—*Politics,* into *The Proportioned Adjustment of Material Interests, and of Social Relations.*

4.—*Ethics,* into *The Science of Proportioned Conduct.*

5.—*Hygiene,* into *The Science of Proportioned Living.*

6.—*Education,* into *The Science of Training and Developing a Proportioned or Beautiful Race.*

7.—*Æsthetics,* into *The Science of Proportioned Taste.*

8.—*Fine Art,* into *Proportioned Art.*

Pending the publication of my work I cannot enlarge upon the subject, but I may say that the Mathematical Theory of Evolution is convincingly *optimistic.* W. Cave Thomas.

THE NATURE OF CONSCIOUSNESS.

[1801]—C. N.'s ideas (1761) are gradually becoming clearer. Her former admission that "*something* exists independent of consciousness," carries with it, of course, the fact of this "something's" externality, and her present admission that "every valid concept must certainly be correspondent with a thing," defines exactly what that "something" is, and therefore completes her surrender. My "vulgar realism of tripe and onions" will thus have had the effect of leading her from the refined philosophic tomfooleries of Lewinsianism to a higher, a nobler, and a wider conception of the relationship that subsists between herself and her surroundings.

If she will ponder carefully the subjoined extracts from G. H. Lewes, it will help her to overcome the misgivings she still evidently feels, as shown by her use of the terms "valid concept" and "group or synthesis of sensation"; as if a *concept* could be non-valid, or a *group of sensations* could in some way fail to fully represent the things so grouped.

In his "Problems of Life and Mind," Vol. II., pages 43–45, G. H. Lewes writes:—

When "an insight into psychological processes teaches us that knowledge is a process of two factors, the organism and the medium, the knowing mind and the object known, we come round to the starting-point, and still say that to know a thing as it *appears*, is to know it as it *is*, under the objective and subjective conditions of its appearence.

"A thing being a group of relations, varies under varying conditions. Obviously this changing group will not be the same throughout the changes, but it is here and there precisely what it appears here and there—the manifestation changes with the conditions.

"The famous distinction, therefore, between is and appears is either a logical artifice or a speculative illusion. The logical artifice points to the distinction between general relations and particular relations. The speculative illusion assumes that the knowledge of things being only of appearances, can never be a knowledge of things as they are in their inmost nature.

"Our utter inability to form a conception of the aspects which known objects would form to a new sense, ought long ago to have shown the inanity of speculating about the aspects of things in relations not sensible, and ought to have closed for ever the disputes about the supra-sensible. The logical distinction between the inward essence and the outward appearance is simply this:—The Thing considered outwardly—*i.e.*, in its presentation to sense, is the Thing in definite relations; but, besides this, we conceive the Thing as *capable* of other relations which are not definitely specified, or as existing in indeterminately fluctuating relations—*a mere possibility of appearance*," which possibility of appearance has—as is proved above—*to us*, no possibility whatever."

J. S.

VITAL FORCE.

[1802]—"Meter" (Letter 1759) almost piteously appeals to us not to seek to destroy people's reverence, not to rob the world of hope, &c., which alone affords any valid reason against a man doing just as he chooses. I would briefly console him. Men cannot "do just what they choose." If there was no reverence, no hope, no fear in the world, there would still be "necessity;" the inexorable laws of cause and effect, actions, and inevitable consequences. The first law of nature is "self preservation;" from it spring all notions of right and wrong, the golden rule, Do ye unto others as ye would be done by, for what you consider it wrong for others to do to you, it must be wrong for you to do to them.

F. W. H.

P.S.—I would further impress on "Meter" that knowledge is superior and, in fact, supersedes "belief." Teach people that, As thou sowest, so shalt thou reap; that evil actions produce evil consequences; that "sins" cannot be forgiven; that wrong done to ourselves or to others must be suffered for; that the laws of nature cannot be transgressed with impunity; that experience proves to demonstration, that on our "actions," not on our "beliefs," hopes, or fears, depends whether we shall be happy, contented, and prosperous in our present life, here and now.

MIND AND MATTER.

[1803]—"F. W. H." really does not seem to understand the difficulty some of us find in accepting, just as they stand, the axioms of the Haeckel philosophy. The difficulty I, for one, find is this: I grant all the premises. Every atom has a soul. Every combination of atoms has a composite soul, whether the combination is organic or inorganic. Every molecule of carbonic acid has its composite soul. When the carbonic acid is split up, each atom of carbon and oxygen can call its soul its own again. So each plant has its composite soul, and each animal too. So far, all is plain sailing; but now comes the difficulty. Man has a composite soul exactly similar to the composite soul of carbonic acid, a plant, or a dumb animal. Two of the attributes of a man's soul are said to be consciousness and volition. Therefore, the souls of carbonic-acid, a plant, and a dumb animal possess consciousness and volition, or man is the only combination of atoms which possesses them, just as he is the only animal that can speak. There seems to me no escape from one of the horns of this dilemma. One of Darwin's main propositions to which "F. W. H." refers indirectly—namely, that the life of the individual is a type of the life of the species—is perfectly untenable on the theory of gradual evolution. Where in the life of the species, according to the theory of gradual evolution, is the jump the individual makes on his first appearance into the light. If there is a corresponding jump in the history of every species of placental mammals, what becomes of the theory of gradual evolution?

Again, admitting all Haeckel's premises about matter having a soul, what is there to prevent the composite soul of the solar system having the same control over the matter of the system that a man's has over his body? Suppose the sun uses the force of gravity towards the planets because he likes them, and so cannot help using it towards comets (just as when a man beckons to three people he attracts them all when he only wants one), nevertheless, lets the comets know he does not want *them* by blowing them all to pieces. What a delightful solution to the much-contested problem of the cause of comets' tails! On the other hand, why should man, if Haeckel's doctrine of universal law be correct, be the only combination of matter which is able to change its mind?

Of course, it is more satisfactory to explain phenomena in a simple natural way than to have recourse to a supernatural miraculous way. But, when Sir Charles Lyell wrote his "Principles of Geology," the book that made Darwinism possible, it was the custom to explain every geological phenomenon by a cataclysm, or an earthquake, or a flood; nevertheless, Sir Charles himself pointed out that when the crust of the earth was thinner, earthquakes and volcanic eruptions produced very different effects to what they do now. Each philosopher in turn calls his the simple natural way. None ever dreams there is more in heaven and earth than in his philosophy. Jos. W. Alexander.

INFINITE DIVISIBILITY.

[1804]—Does not the difficulty concerning infinite divisibility arise from the confounding of two separate questions, of which the one is concerned with natural history or physics, and the other with either formal logic or metaphysics?

The question whether or not there is a limit to the divisibility of matter is surely a question of physics. Matter may be composed of small portions capable of resisting the disintegrating action of any natural process whatever. These portions will then be, physically speaking, indivisible; and we must then say that there *is* a limit to the divisibility of matter.

Whether or not this is the characteristic of matter is a question of science, and must be settled, if settled at all, not by any intuitive intellectual effort, but by actual experiment.

The other question is not a physical but a metaphysical question. In this sense, "infinite divisibility" is no longer concerned with the divisibility of any substance by any force, but is concerned with the divisibility of a mental abstraction, and, therefore, has no more to do with the divisibility of an atom of matter than the triangles and circles of the geometer have to do with those of the brassfounder.

If these considerations are applied to the example given by "Hallyards" (1747) of the disk and its centre, it will be clear, I think, that the difficulty does arise from the confusion to which I have referred.

The disk of which he speaks and thinks is a piece of metal, cardboard, or other substance; but the centre of which he speaks and thinks is the geometrical centre of a geometrical circle, and not a material atom.

Descartes rightly taught that one of the requisite precautions for the discovery of truth is to divide a complex question into its components. Let us, therefore, begin by separating the empirical question as to the structure of matter from the metempirical questions of ideal geometry.

I believe this problem has been discussed by Mr. G. H. Lewes in "Problems of Life and Mind," and also by Prof. Clifford in one of his published "Lectures and Essays"; but I have not the books to refer to. M. B.

GRAVITATION.

[1805]—"No two gases of different composition can remain in contact with each other without mutually intermingling or diffusing themselves through each other. . . . . . But for this diffusion, and the fact that it overpowers gravitation, we could not live upon the earth."—KNOWLEDGE, p. 539.

May I not claim this as another influence counteracting gravitation as a *universal* law? By it, carbonic acid gas *should* always be lowest; which in practice it is not; yet no chemical mixture prevents its obeying the law. HALLYARDS.

A OR AN?

[1806]—I agree with your correspondent, Mr. E. A. Phipson, in disliking the use of the article "an" before an aspirated "h." But will he permit me to remind him that it is hardly correct to describe the practice as "the present fashionable affectation"? If he will take the trouble to look at Browne's "Vulgar Errors," Book v., chapter 21, he will find the following sentence:—"If *an* hare cross the highway, there are few above threescore that are not perplexed thereat." So in Proverbs, chap. xi., v. 9, we read—"*An* hypocrite with his mouth destroyeth his neighbour." Again, in St. Matthew," chap. xvii., v. 1, we find the expression—"*an* high mountain apart"; and I am sure that thousands of instances might be called from the best sources of "English undefiled," to show that the usage which Mr. Phipson stigmatises as modern is, if the hyperbole may be pardoned, "as old as the hills."

PHILIP KENT.

EYEBROWS.

[1807]—I should be glad if any reader of KNOWLEDGE would give me information on the following points:—Are eyebrows supposed to have developed as a protection for the eye—those subjects who had the more hairs having had their eyes better protected, and therefore (other things being equal) survived as the fittest; or are they the result of natural selection for beauty's sake? If the latter, how is it that the Northern Chinese are almost wholly without them? I have it on a Chinaman's authority that eyebrows are considered by the natives to add beauty to the face (and, for all I can find to the contrary, their ancestors must have thought likewise), and yet nine out of every ten one meets in the streets have hardly any whatever. Or, lastly, supposing eyebrows to be the remains of hair which once covered the whole forehead, are we to consider the Chinaman as in a more advanced state of evolution than we "foreign barbarians," and to believe that the inexorable law of Progress will compel us to follow in his "celestial" footsteps? One feels inclined to say, "God forbid." E. T. C. W.

Peking.

DISINTEGRATION OF THE WEALDEN SANDSTONE.

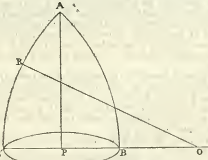
[1808]—A correspondent (letter 1779), in alluding to certain markings on rocks at Tunbridge Wells, uses these words: "They must have been abraded in almost historic times." This sandstone formation, like all the Wealden strata, is a fresh-water deposit, composed of quartz, more or less comminuted, and fine clay (loam) in varying proportions, held together by a solution of iron. It is not affected by frost, but the solvent power of rain-water in time finds out its softer parts, and washes them away, leaving the harder or insoluble parts standing up in relief as irregular ridges, hence the honeycomb markings, or pits, to which your correspondent alludes.

The time required to produce this honeycombing under the ordinary condition of the rock is, I think, far longer than the three thousand years or so constituting the historic period. I have formed this opinion on the following grounds, made from personal observation.

Trinity Church, Tunbridge Wells, was built about sixty years ago of this stone, dug from quarries within a mile of it; the church is unprotected from the south and west, yet the tool-markings upon the stones are as sharp and well-defined as if made yesterday. The oldest squared-stone erections that I know built of it date from about 1350; take Bodiam Castle and Etchingham Church as examples; they show little or no sign of weather wearing, and the scanty tool-marks of the workmen, made more than 500 years, are still visible. The present appearance of this stratum, exposed as rocks and cliffs at Tunbridge Wells and in East Sussex generally, is due to two causes, the primary one being the enormous denudation which followed in comparatively recent geological times its upheaval from great depths, the second and chief cause being subaërial denudation. The cracks and crevices, from the fraction of an inch in width to any number of feet, are due entirely to its elevations with all the Tertiary deposits upon it. These have all been denuded, except a bit or two on the south coast. The town of Seaford is built on one of the remnants of the Tertiaries; the horizontal sandstone-floor could not stand the pressure upwards without breaking, hence these fractures. JOHN SHARP.

FORM OF THE HEADS OF PROJECTILES.

[1809]—Captain Martin, (late) R.N., sends the following for solution:—



Let A, B, B′ be an ogive or solid of least resistance in a resisting medium, described by the revolution of the arc A B about its semi-chord A P. It is required to find what the length of the radius O R should be in order that a solid whose volume should be the greatest possible, whilst its surface should be the least possible, should be described.

My solution makes $R = 4{\cdot}426,\ B'P\,B$
$= d$

The value to satisfy these two conditions.

FECUNDITY OF NATURE.

[1810]—Miss C. F. Gordon Cumming relates (in the *Pall Mall*) that in 1883 there were killed in Cyprus no less than *two hundred thousand millions* of locusts. Immense efforts, and about £60,000, (in four years) were necessary. Am I not justified in suspecting that on our planet survival is easier than extinction?

When I was a child, I set myself to clear a garden of slugs. I

killed from two to three hundred every evening of the season, during three years; the fourth summer there was hardly a slug to to be found.

HALLYARDS.

PRINTERS' DEVILRY.

[1811]—KNOWLEDGE has always had, I think, an excessive amount of errata and mistakes;* but I must confess that the *Saturday* runs you hard sometimes. Thus, May 30, the *S. R.* has "whether Bacon's soul went to *Arthur's bosom* (where it would in some of its moods have got on excellently with another inmate)" . . . and below—"during his sojourn in *Arthur's bosom.*" Now, I cannot imagine how any being able enough to have developed type as his "protective peculiarity" could fail to see by the allusion to Lazarus—whom he must have heard of at church, if nowhere else—that, if even his copy had had but "A——," there could be no hesitation in filling up. "Brehon" laws of course appears as "Breton" in the same journal; and I suppose no one ever got "patristic" in a first revise. However, it is not always subordinates who are preternaturally obtuse. "As to this I confess I am *tomdidemus*" (in an old letter). Can there be a doubt as to what this means? Yet the reviewer declared it insoluble. A confrère flashed the levin of scorn on a hapless novelist for having a "Bp. of ——shire;" declaring no *district* ever to give title to a see; in face of Man, Galloway, Argyll, the Isles, Meath, Ossory, &c.

Considering how many broken-down scholars there are "around" living on their wits, (which must be good, or else they would starve) it seems strange they cannot be *casés* as press-correctors, where they would be "the right men in the right places."

HALLYARDS.

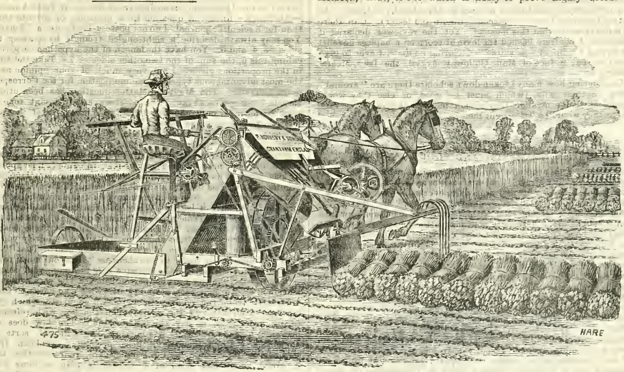
LETTERS RECEIVED AND SHORT ANSWERS.

J. WEBB. I do not know who the London agent for the *Sidereal Messenger* is. Try Grevel, Trübner, or Wesley & Son. No one but Mr. Nasmyth has, so far as I am aware, ever seen "willow-leaves" on the sun, but the "rice-grains," "granules," or "leaves" of other observers may be seen with apertures of 6 in. and upwards. —A KREOPHAGIST. Assuredly not; it is utterly baseless.—J. L. P. Shall be handed to "Five of Clubs" on his return to London.—DR. LEWINS. You compel me to speak plainly. Briefly, then, I cannot convert the columns of KNOWLEDGE into a propaganda of your doctrines for two simple reasons. The first is that this journal was established for the purpose of affording efficient and trustworthy instruction in what is proved and *known* in Natural and Physical Science, and by no means for the setting forth of the subtilizations of Metaphysics. The second you will regard doubtless as a merely sordid one; but this will scarcely affect its validity. If I were to favour my readers weekly with columns of declamation in favour of Atheism pure and simple, I should speedily have so very limited a number of such readers as to render the paper a ruinous loss to its proprietors, which I could assuredly plead no justification for doing. This is why I suggested to you to start an organ of your own. Surely, as sporting men say, "you ought to back your own opinions."—W. CAVE THOMAS. He lives in Italy. If I can ascertain his address accurately, I will forward it.—D. WALKINSHAW sends a new system of spelling, which surpasses all the systems of phonetics that I have, so far, seen in simplicity. It contains no new characters nor letters. Try the Philological Society.—J. FOULERTON. Received with thanks.—H. A. BULLEY. The discussion is a very barren one. You only meet your opponent's dogmatic assertions with others equally dogmatic, and, let me add, equally unprovable.—COMMENTATOR. Please send your exact address, as there is a letter lying here for you.—W. SOUTHWICK ROGERS. In its existing stage it is simply a commercial speculation which I certainly do not feel called upon to advertise gratis. — JOHN HAMPDEN. Don't talk nonsense! The gnomonic projection of the circles of the sphere upon the plane of the terrestrial equator was employed ages before either you or I were born or thought of. The southern (outside) part of your map is wildly wrong!—COMMENTATOR. *Requiescat in pace.* Observe what factitious importance such a discussion confers on the subject of it.—JAS. S. GREIG. I shall be happy to accept it as a voluntary contribution. Should you not agree to this, I will return your MS. on receipt of a properly-addressed and sufficiently-stamped envelope. The conductor is in the United States. — HALLYARDS. All safe to hand, and will appear in instalments. The *précis* was not set up after what you said, your remonstrance reaching me in time for me to stop it.—M. B. The actual superior limit of the atmosphere is supposed to be about 200 miles above the earth's surface. This estimate is derived from the observations of twilight by M. Liais, in Rio Janeiro. I know nothing of Faraday's experiments establishing the limit of diffusibility of mercury. Your concluding problem is insoluble without more data than we possess at present.—J. H. COBBETT. The image of any given star—Sirius, Aldebaran, or what not—formed by the object-glass of the telescope, is thrown on to the slit of the spectroscope, so that we of course know what object it is that we are examining spectroscopically. Light travels in straight lines, so that no other rays can reach the eye than those from the object under observation. Light passing *across* the field of view is absolutely invisible (see Vol. V., p. 306). Do you not see that if the light of the different stars traversed the immaterial population you postulate, it would render the stellar spectra all alike—or at all events they would have a vast amount in common. But for the kind of discussion it would provoke, I should print your very amusing letter *in extenso*.—R.A.H. Shall be submitted to the Conductor immediately on his return from America. —ARCTURUS.—Rather a question for a crammer or private tutor than for a scientific journal. I do not possess Todhunter's "Euclid." You may always describe a right-angled triangle by making the sides = 3, 4, and 5. You have the length of the hypothenuse given; calling this 5, the sum of the two other sides = 7. Take the sides in the proportions given. I am very much of your opinion as to the most advantageous types of communication for the Correspondence Columns. The Mind-and-Matter question has been utterly thrashed out.—STACKYARD. The courtesy and pleasant tone of your criticism is only equalled by its candour. I trust that you will find future numbers altered in precise compliance with your requests.—W. M. K. With a preliminary request that you will study section 3 of the concluding paragraph on p. 505 of Vol. VII., I would ask you seriously whether you expect me to insert eighteen sheets of the most dogmatic possible assertion, unsupported by one atom of proof? There is intemperance in language and argument as well as in drink. Alcohol does mischief. Granted.—but so does water. Because a woman uses it to drown herself in, am I never to have a bath? When you reiterate that favourite phrase from Mr. Tweedie's tracts, "Our drink bill," does it not strike you by how many millions the population of these islands increases in every decade, as shown by the census? Surely you do not expect the consumption of alcohol to diminish! That "the road of moderation leads to drunkenness" is, you must really pardon me for saying, merely offensive cant. Again, your allegation as to what "every sensible person believes" is very arrogant, inasmuch as it brands with stupidity everyone who dares to think differently from the comparatively small clique to which you belong. Your ideas of the operation of the law with reference to fire are vague, to say the least of it. The law does not prevent a man having gas-burners, &c., in all sorts of dangerous positions; while it does prohibit a publican from serving an intoxicated man. Furthermore, your assertion that it would be for the good of a temperate man to deny himself any stimulant whatever is simply the expression of your opinion. Thousands of the best and wisest men who have ever lived have thought differently. Yes, I can say that, living artificially as we do, strong drink is a *very* "necessary article of consumption for proper nourishment of a man in ordinary health." When gentlemen wore nothing but a few dabs of woad on their persons, and ate acorns, spring water was obviously the most fitting beverage for so pig-like a diet. And here, again, you are guilty of making an assertion without a fragment of proof when you assert that "the leading men of the medical faculty" think total abstinence reasonable or wholesome. Why, I could fill this column with the names of the very greatest physicians and surgeons, all of whom not only recommend alcohol, (in strict moderation), but take it themselves. Your two questions are modest demands for me to prove a negative—which no one is called upon to do. The question as to the superior "vitality and endurance" of water-drinkers was tried out in the hayfield in an English county only last year, with the result that the beer-drinkers beat the brethren of the pump off their heads. As for your evidence of longevity, it is worthless. A vast proportion of the oldest men whose deaths have been recorded have been both moderate drinkers and smokers. And can you give me the name of one single insurance office which takes teetotalers' lives at a lower premium? To be brief, your tremendous letter consists of assertion from beginning to end. My first impulse was to print it *in extenso*, and let the reviewer of the book which evoked it reply to you. In mercy to you, though, I have done so myself. From the days of Noah downwards men have taken wine, and will continue to take it, the United Kingdom Alliance notwithstanding.—M. HUMM. Lectures will be duly announced.—GEOLOGISTS' ASSOCIATION. Received.

* [How many of these have their origin in the detestably bad writing of people to whom it is impossible to send proofs?—ED.]

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE being a popular magazine) than is accorded by the most excellent trade journals.

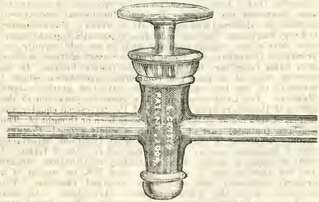


CRADLE FOR HARVESTERS.

[Patent No. 10,908. 1884.]—This is a new Sheaf-carrier, by Messrs. R. Hornsby & Sons, Limited, of Grantham, applied to their sheaf-binding harvester, for gently delivering the sheaves upon the ground in lots of three, four, or five at a time, in windrows, as well as for always carrying the sheaves round the corners of the plot, thereby preventing the possibility of the corn being trodden upon by the horses. This novel arrangement was first introduced at the binder trials of the Royal Agricultural Society at Shrewsbury, in August last, where it was tested, and pronounced by all to be the most perfect ever produced. The sheaf-carrier consists of a cradle made in two parts, and opening in the centre, one part being hinged underneath the binding apparatus where the sheaves are dropped, and the other carried by supports projecting from the machine, and hinged thereon. The part nearest the binder is made of a single board, mounted on an iron support, jointed close underneath the binding table. The outer bar consists of a wooden board supported at each end, and carrying four steel prongs, the extreme ends of which meet the edge of the board about the middle of the cradle. The two halves of the cradle are coupled and controlled by a rod. Both these parts are held in position by the driver's foot until a sufficient number of sheaves (three, four, or five) have been received from the binder into the cradle, when he lifts his foot, allowing the weight of the sheaves to open the cradle in the centre, the board falling towards the machine and the prongs outward, the sheaves falling gently to the ground, and being, by the opening action of the cradle, spread on the ground side by side, and in no case one upon another, as is done by other forms of sheaf-carriers. As the machine travels forward, the open cradle passes clear of the sheaves, and is again closed in position to receive further sheaves by the pressure of the driver's foot. In cases where the cut crop is not required to be tied into sheaves, by not putting any string in the binder, the sheaves are ejected loose into the carrier, and deposited in heaps or windrows at any distance desirable for the convenience of loading in accordance with the size of the crop. The advantage of this patented invention is that it enables the driver to absolutely control the delivery of the sheaves, carrying three, four, or five at a time, and placing them in windrows, as well as by always carrying forward the sheaves at the corner of the plot, to secure one or more clear roads out from the centre of the field. The machine works equally well on hilly or on level ground.

THE VACUMOTER.

THIS invention, introduced by Mr. Cetti, 36, Brooke-street, Holborn, E.C., is one which is likely to prove highly useful to physicists. It consists of a glass tube, provided with a tap, having a sealed bottom, while the stop-cock itself is furnished with a receiving cup in which is placed glycerine or some other liquid,



which, adhering to the glass, prevents the ingress of air, and thereby enables the experimentalist to obtain something more nearly approaching a perfect vacuum than could be hoped for with the ordinary glass stop-cock, be it ever so well made. The simplicity of this patented tap is not the least of its recommendations.

Our Chess Column.

By Mephisto.

BRITISH CHESS ASSOCIATION.

Friday last the proceedings of the British Chess Association were brought to a close. An adjourned game between Bird and Guest was declared drawn. This ended the Tournament, the winners of which are :—

First prize	J. Gunsberg	Score 14
Second ,, }	H. E. Bird..............	,, 12
Third ,, }	A. Guest	,, 12
	who divide the two prizes.	
Fourth ,, ...	W. Pollock...............	,, 10½
Fifth ,, }	G. A. MacDonnell......	,, 10
,, ,, }	R. Loman	,, 10
	who divide.	

Consultation Tourney.

First prize—Mason and Donnisthorpe.
Second prize—Bird and Hewitt.
Third prize—Gunsberg and Hunter.

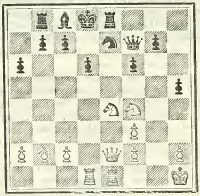
Final score in the B. C. A. Tournament :—

	Won.	Lost.	Drawn.		Won.	Lost.	Drawn.
Bird	10	1	4	Loman	9	4	2
Donnisthorpe	8	7	—	Mackeson ...	—	14	1
Gunsberg ...	13	—	2	Pollock	10	4	1
Guest..........	11	2	2	Rabson	1	13	1
Hewitt	6	7	2	Reeves	5	8	2
Mills	4	8	3	De Soyers...	3	10	2
MacDonnell.	9	4	2	Wainwright.	8	5	2
Mortimer ...	5	8	2	Rumboll ...	4	11	0

Position in the last game played in the Tournament between Messrs. Guest and MacDonnell.

G. A. MacDonnell.

Black.



White.

A. Guest.

White won the game by the following masterly line of play :—

1. R × P (ch) !	B to Q2

White's move is as effective as it is brilliant. If Black plays P × R White obtains an advantage by 2. Kt × P, Q to Kt sq. 3. Kt × R, Q × Kt. 4. Kt to Q5, &c.

2. Kt to K6 (ch)	K to B sq.
3. Kt (K6) to B5	B to Kt4
4. Q to Q2	B to B3

Here Kt to B4 would have been better.

5. R to Q sq.	Kt to Q4

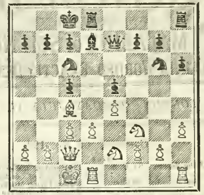
If Q to Kt sq., White wins by R × B, threatening mate.

6. R × Kt	B × R
7. Q × B	Q × Q
8. R × Q and White won.	

The following position occurred in a game between Messrs. Guest and Gunsberg :—

J. Gunsberg.

Black.



White.

A. Guest.

Black continued as follows :—	Kt to R4
B to Kt3	B to B3
Kt to Kt3	Kt to B5

Anticipating White's intention to play Kt to B5 and P to Kt3, Black prepares a surprise.

Kt to B5	Q to B3
P to Kt3	R × P!

A deeply-involved sacrifice, which leads to many complicated variations, very difficult indeed to examine in actual play, with a time limit of twenty moves an hour.

R × R	B × P!

A necessary sequal to the former move. Besides the actual line of play—Kt to Q7 (ch)—adopted by White in this highly interesting position, he has two other moves at his disposal, both of which, we think, however, should lead to a slight advantage of Black, as the following variations will show :

(a)		(b)	
P × Kt	Q × Kt	R to Q8 (ch)	R × R
Kt × P (a)	P to B5 and wins	Q × B	Kt to Q6 (ch)
		K to Kt sq.	Kt × BP
(a) Kt to R4	Q × P (ch)	Q to B2	Kt × R
Q to Q2	Kt × B (ch)	P to Kt4	P to KKt3
P × Kt	B × R and wins	Kt to R4	P to K5 and wins

There are many other possible moves both for White and Black, from all of which, however, Black should emerge with a good game. White continued :—

Kt to Q7 (ch)	Q × Kt
P × Kt	P to B5
R to Q8 (ch)	R × R
Q × B	P × B
P × P	Kt × P (ch)

Remaining with a Pawn move for the End-game.

INTERNATIONAL TOURNAMENT AT HAMBURG.

The bi-annual meeting of the German Chess Association will take place at Hamburg, and begin on the 12th inst. According to reports received, the entries are numerous, and comprise most of the best players in Europe. Liberal prizes have been offered, and it is expected that more than the average number of competitors, on such occasions, will this year journey to Hamburg. Of English players Messrs. Bird, Blackburne, Gunsburg, and Mason have entered their names. Captain Mackenzie, of New York, is also expected at Hamburg.

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ILLUSIONS OF THE SENSES.

BY RICHARD A. PROCTOR.

PROFESSOR LE CONTE of the California University has recently published in the *North American Review* an interesting paper on the Evidence of the Senses, in which he shows that on the one hand the senses often afford most incorrect information while on the other the powers of such scientific instruments as give exact information would be utterly unsuitable substitutes for our less exact senses. Sight tells us that an object is flat when it is round, touch that an object is double when it is single, hearing that sounds come from close by when they really reach us from a great distance; but on the other hand to have eyes with telescopic power, or fingers as sensitive as a chemist's balance, or ears with the sound-gathering qualities of the microphone, would unfit us for the kind of life we have to lead upon this work-a-day world of ours.

I propose now to discuss the question dealt with by Le Conte, with special reference to the liability of our senses to various forms of error. Taste and smell need not here occupy our attention. They are less used than the other senses in scientific research; and so far as the purposes to which they are chiefly directed are concerned they are in the main trustworthy. They may deceive us by presenting as pleasant what is really deleterious, but once experience has determined the qualities and effects of substances having such and such taste or odour, we are not often deceived in identifying those substances thereafter.

The sense of touch is commonly understood as including the sense of heat-effects. But here, as Reid long since pointed out, our division of the senses is unsound. Undoubtedly the sense of touch is entirely distinct from the sense of heat,—though we may be said to *feel* in both cases. The error probably arose from the circumstance that the same organs seem employed in noting the effects of contact and the effects of heat. I touch a surface to see if it is hard or soft, rough or smooth, just as I touch a surface to see if it is hot or cold: moreover there is no part of the body which is sensible to the effects of contact which is not also sensible to the effects of heat and cold. But we recognise a marked difference between the sense of touch when the tip of the tongue is employed for the moment as the organ of touch, and the sense of taste; yet the difference between taste and touch is not more marked than the difference between heat and touch.

Therefore in dealing with errors affecting the evidence given by the sense of touch, I consider only those really relating to the effects of contact, dealing separately with those relating to the effects of heat and cold.

Aristotle long since pointed out how the sense of touch may be deceived when the organs of touch are employed in some unaccustomed manner. It was he who first mentioned, if he did not invent, the experiment of rolling a pea between the tips of the first and second fingers, after the second finger has been crossed over the first. This experiment is instructive as showing how much of the significance of the teachings of our senses may be due to the effect of long-continued training. Every time we touch with the finger-tips an object of known shape, we are in reality teaching our fingers that such and such impressions have such and such a meaning. When two fingers are crossed, the finger-tips receive different impressions from those which they receive in their normal position, and we naturally misinterpret the meaning of the impressions so received. Thus if I touch with my first and second fingers the sides of a space shaped thus ◡, the outsides of the fingers come in contact with the curved surface, whereas the insides of the fingers feel such a surface as this,—⌒: so soon as the fingers are crossed these effects are reversed; the outsides of the fingers are brought together by the crossing and touch a surface shaped thus ⌒, telling us apparently that it is really a surface shaped thus ◡ that we are touching. To test this apply the crossed fingers to a surface shaped ⌒⌒, so that the fingers touch the convex curves near their place of meeting: now we find that we no longer seem to be touching two curves, but one. It must be admitted, however, that this experiment is less striking than the other; the information conveyed by the finger-tips instead of seeming definitely and decidedly incorrect, appears but vaguely erroneous.

Let us try a few other experiments with crossed fingers. Take a penholder or pencil, and with first and second fingers crossed slide the finger-tips along the pencil or holder. If the eyes are closed the fingers seem to tell us emphatically that we are feeling two parallel rods. Yet if the eyes are directed to the finger-tips the illusion disappears. This is not, however, because the eyes assure us that there is but one pen or pencil; it is because the eyes show us that the fingers are crossed. To show that mere knowledge will not save us from the illusion, feel with the crossed fingers the tip of the nose. We know certainly that we have but a single nose-tip; yet the absurd and illusory feeling that we have two noses is immediately produced. The illusion is strengthened if the crossed finger-tips are caused to slide along the ridge of the nose. Very curious illusions are produced if the crossed finger-tips are carried along either lip, or between the lips, or along the bone ridge below either eye or along the ridge above the eye, or round the ear, and so forth. But in my own case, the oddest illusion of all is obtained by crossing the forefinger behind the little finger, (both being bent somewhat towards the palm, so that the second or third fingers are behind them) and then feeling with these crossed fingers the

tip of the nose: for now, not only does the nose appear double, but *one nose appears to be longer than the other.* One can easily understand why this is. Under ordinary conditions the first and little fingers cannot at the same moment feel two bodies which are equidistant from the observer,—or let us say from the palm. If for instance we place the forefinger tip on the end of a white note on the piano, the little finger tip can only rest on the end of another white note by bending the hand: we can however touch an end of a black note with the forefinger tip while the third finger tip touches the end of a black note, without bending the hand. The lesson taught, then, by constant experience (unnoticed through its very familiarity) is that two bodies so felt extend to different distances. But in the experiment with crossed forefinger and little finger, the finger-tips touch at the same moment the same nose-tip: which appears double because touched by the outside edges of the fingers, and the two noses appear of unequal length because it seems as though the little finger touched one while the forefinger touches the other, each of them at the tip.

Other singular effects may be produced by crossing the fingers, varying the combinations. If the forefinger and second finger of the left hand be crossed as well as those of the right, and a small object be held between the crossed pair of each hand, the most incorrect ideas of the shape of the object are given. I have just tried the experiment for instance on a small box of pen-nibs, holding two opposite corners, one between the crossed finger-tips of the right hand the other between those of the left hand; it was impossible to realise that the object thus held had any regularity of shape at all.

Another experiment on the sense of touch depends on the circumstance that usually the outsides of the hands are so placed that if both touch two surfaces at the same time those surfaces are not in the same direction. Of course the two hands can be placed side by side with their backs uppermost and a flat surface may so touch both; but usually the palms are towards each other, and this is especially the case when both hands are used in holding anything. Place the hands together palm to palm, then cross the arms so that the hands are back to back; if now a book is held between the backs of the hands its edge appears bent. The force of this illusion is different with different persons; but let not those who are not affected by it rejoice as being less easily deceived than their fellows; for, as Sir David Brewster remarks in speaking of an illusion affecting sight, it often happens that the most observant are those most completely deceived by such illusions.

There is another curious illusion of touch which appears to depend on the teaching which the hands and arms have had (unconsciously) in estimating the dimensions of bodies held in the normal way, in front of the body. Suppose a book lying on a table before you, the back of the book being towards the right. Take hold of it by the nearest right-hand corner (that is, holding it by the end of the back nearest to you) and pass it over the right shoulder so that the face which had been uppermost lies against the back of the right shoulder in a nearly vertical position. Now pass the left hand round behind you under the left shoulder-blade till you can grasp with it the edges of the leaves. You will now find that though you *know* from the feel of the edges that your left hand holds a side several inches from the back held by the right hand, that side of the book appears to be a continuation of the back of the book,—so far as direction is concerned. The explanation appears to be simply this:—When an object like a book is held in front of the chest, the right hand holding one side, the left hand reaches the opposite side without effort or stretching; while with a slight amount of stretching the side held by the right hand can be reached: now when the book is held behind the back in the way described above, an effort is required to reach with the left hand the side opposite that held by the right, hence the same effect is produced on the mind as when in the normal way of holding objects of the kind the left hand is stretched over to the right hand's side of the object; thus instead of the left hand touching the side opposite that held by the right, it appears to touch the same side.

So much for illusions affecting touch. Or rather, these afford sufficient evidence that the sense of touch may be readily deceived. But in reality, scarcely a day passes without our noticing, if we are at all observant, illusions affecting this sense. If we observe the circumstances under which such illusions occur we generally find that they arise when some organ of touch is used in a novel or unusual way. But in the majority of cases arising in ordinary life the sense of touch acts in combination with either the sense of sight or the sense of hearing, and consequently the illusions arising are not such simple examples of errors in the evidence afforded by the sense of touch as those considered above.

(To be continued.)

LIFE IN DEATH.

BY WILLIAM CURRAN.

(Continued from p. 26.)

LET us now turn to another phase of the question, and see how far that deviates from credibility, or accords with the experience of our common life. Dwelling, apparently with much complacency, on what he calls the *Horrendus Maximini interritus*—*alias* the painful death of the tyrant Maximinus—Lactantius says (*De Mortibus Persecutorum*):—"*Deinde post multos gravesque cruciatus, cum caput suum parietibus infligeret, exilierunt oculi ejus de caveis*"; and it is worth while asking whether any one, sane or otherwise, can *per se* "dash out his own brains," or cause his own eyes to start or jump out of their sockets. Grave writers and "able editors," as Carlyle would call them, say the thing is possible, and we occasionally read of such performances in connection with police-cells, lunatic asylums, and the like. Thus the reverend author of a little book called "A Popular History of the Insurrection of 1798," after mentioning the dreadful sufferings that were endured by those who were subjected to the horrors of half-hanging and the pitch-cap in that year, says, p. 72, that the victims of these pleasantries "dashed their brains out, in the madness of intolerable pain, against some neighbouring wall, and thus put an end at once to their life and misery"; and the following occurs in Mr. O'Hagan's translation of the Song of Rowland":—

> He (R.) saw the Saracen seize his sword,
> His eyes he ope'd and he spoke one word—
> * * * * *
> On the golden crest he smote him full,
> Shattering steel and bone and skull;
> *Forth from his head his eyes he beat,*
> And cast him lifeless before his feet,*

where we may safely leave him for the present.

* Somewhat akin to this is the crime or occurrence mentioned in

If now, making every allowance for the poetic licence assumed above, as well as for the strange juxtaposition of bone and skull, as if they were not here as elsewhere identical, we come to the beating out of the eyes and the dashing out of the brains, and ask ourselves if such things ever can or ever do happen, our answer will be that they probably never do. And yet stranger occurrences than even these have been gravely recorded by eminent historians. As an instance in point, we will quote the following from Milman. Mentioning the hard usage according to which the Syndic of the Jews was obliged to salute the Mayor of Toulouse about the year 980, he says (*ut supra*, vol. ii., p. 146) that: "A stern, iron-handed magistrate struck the poor Syndic with such force as to scatter the brains of the unfortunate unbeliever"—and the hand that achieved this feat must, indeed, have been made of iron or other equally potent material; for unless this wretched Syndic was suffering from that very rare condition called *Mollities ossium*, or that our magistrate had the strength of a Hercules, it is hard to conceive how such a result could follow from such a cause. And yet there is no affectation of poetic licence or unreality here—the possibility of the thing is taken for granted, and there is no such qualification as even a query or a note of admiration could supply. All we need, therefore, say in this connection here, is that where grave and learned writers like Milman put forward such statements without question, we ought not to be surprised when we find Scott and other romancists of his class investing their heroes with such attributes as are clearly beyond the reach of ordinary mortals.

It is, we believe, generally admitted that negroes have sometimes succeeded in committing suicide by swallowing their tongues; in other words, by doubling them back, and then drawing them into their throat, so as to stop the access of air to the lungs;* and excision of the tongue is now a recognised surgical operation. But this operation to be successful or effective must be performed by a skilled surgeon or a trained executioner, and persons desirous of shuffling off the mortal coil never dream of trying to do so through the medium of this organ. We have it, however, on the authority of Major Macpherson ("Memorials of Service in India," p. 67) that, "a Khond, captured by our troops in Baramootah, immediately tore out his tongue by the roots and died," probably of the hæmorrhage which such an attempt would necessarily entail. But it does not seem possible for any one to tear out his own tongue with his own unaided hands, and in proof of this we have only to ask our readers to try and seize that somewhat slippery muscle themselves. If they will try they will probably find that they cannot introduce the hand into the mouth without producing sensations that would prove fatal to such an attempt; and, even supposing that they had so far succeeded, how are they to drag—for that's the assumption—this very elastic piece of mechanism from its strong and deep-rooted attachments? The thing seems to be impossible, and we need not fear that our allusion to it will induce any future *felo-de-se* to prefer it to the easier and speedier alternatives of a jump over London-bridge or a resort to the ever-ready razor.

But we must hurry on to a close, and with this view restrict ourselves to one or more illustrative extracts of the character here contemplated. Describing the decisive battle that took place between the forces of Mahomed Shah Adily and those of the famous Akbur, Major Briggs says "Rise of the Mahomedan Power in India," that the former's Commander-in-Chief, one Hemoo, was pierced in the eye with an arrow, which penetrated the brain; "he sunk into his howda from extreme agony, and the greater part of his troops, fearing that his wound was mortal, left him. Raising himself again, Hemoo drew the arrow from his head, and with it the eye from its socket, which he wrapt up in his handkerchief. He continued to fight with unabated vigour until he contrived, with the few men who remained faithful to him, to force his way through the enemy's line." That a brave man should continue to fight for dear life after he had lost an eye, in battle or otherwise, is no very uncommon or extraordinary thing; but that he should do so under the circumstances here disclosed is certainly unusual, and if such wounds as are casually inflicted in this region by the poke of an umbrella-handle or the thrust of a walking-stick prove, as we believe they always do, fatal, we may well doubt the practicability of the feat narrated above.

A writer in the "Philosophical Transactions" (A New Abridgment, vol. iv., pp. 106-7) gives such an account of the effects of a cancer on the brain of a certain person as, if verifiable, would go far to show that Shakespeare's belief, "the man is dead when the brains are out," admits of some qualification. This account may, for brevity's sake, be summarised as follows:—A certain man "had a cancer which spread itself, in spite of the endeavours of the most eminent surgeons of the day, over all the cheek, into his mouth, and across the upper part of his nose, where it perforated the bone and ate away all the flesh round his eye, so that he could take out the latter with his own hands," and we suppose, though this is not actually said, put it into his pocket. It finally exposed the dura mater, and with it the brain itself to view, several portions of which came away. "And what was most extraordinary was that he perfectly retained his senses, and rose every day to dress the ulcer himself till a considerable quantity of the brain had come away." When he died, four days after taking to his bed for the last time, "his brain *was totally consumed*, and nothing remained in the cranium but a small quantity of black putrid matter," and we are gravely asked by this philosophical writer to believe this.

Were we to do so, we would be simply flying in the teeth of all experience, and reducing the researches and the observations of our best scientists to a level with the wild exaggerations of Mr. Holloway or St. John Long. This we decline to do, and if a man may go about his ordinary business without any

the following lines from the old song, "The Clerks of Owsenford," see Roberts' Legendary Ballads:—

"Then he has ta'en the twa bonny clerks,
Bound them frae tap to tae,
Till the reddest blude in a' their veins
Out oure their nails did gae."

The following story from Gilbert's "History of the Viceroys of Ireland," page 63, would, if true, seem to justify the accounts given by Scott and others of their fabled heroes. Describing a feud that existed between Hugues de Lasci, "John's representative, and a powerful baron named De Curci," our author says that the latter was attacked by the former while at prayers in the cathedral of Down, with the following result: "With the pole of a cross snatched from the head of a grave in the churchyard, De Curci slew thirteen of De Lasci's soldiers ere he was overpowered and sent in fetters to the Tower of London."—*Credat Judæus Apella, non ego!*

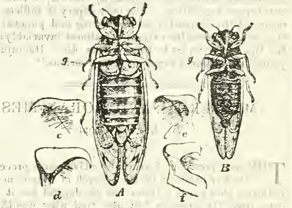
* Woodman and Tidy's "Handybook of Forensic Medicine," p. 956. The following is, perhaps, the most extraordinary case of suicide on record. It is gravely related by Mr. Talboys Wheeler in his able "History of India," Vol. I. p. 323, and runs to the effect that, "Drona, one of the heroes of the Mahábhárata, believing that his son was dead, drew up all the breath of his body into a spot in the neighbourhood of his heart and drove it into his head, upon which the top of his skull was burst open, and his soul escaped through the orifice like a ray of the sun."

brains, there is no good reason why he may not do the same without his head, or why, in a word, the "miracle" of St. Denis may not be reproduced, *puris in naturalibus*, any day, at the Egyptian Hall or elsewhere, in our very midst.

SEVENTEEN-YEAR CICADA.*

BY C. V. RILEY.

OF all the numerous insect tribes no one species is more peculiarly North American, or attracts more curiosity, than the periodical cicada, otherwise known as the "seventeen-year locust" (*Cicada septemdecim*, L.). It will be particularly noticeable the present year, because there is to be, according to the chronology published, the conjunction of two extensive broods.



Seventeen-year Cicada (*Cicada septemdecim*, Linn). A, ♂ of typical form; *c*, *d*, genital hooks; *g*, singing apparatus. B, ♂ of the small form (*cassinii*); *e*, *f*, genital hooks. Colours: (*A*) black, orange and orange-brown; (*B*) black and orange.

There is a voluminous literature on this insect, and a very full account of it was given by the present writer in his "First Report on the Insects of Missouri," just seventeen years ago. In that article it is made evident that, besides a number of broods requiring seventeen years for their underground development, there are others belonging to a thirteen-year race or variety, which he called *Cicada tredecim*.

From the chronological record there given, the brood XXII., which is a seventeen-year brood, and which last appeared in 1868, will appear this summer on Long Island; at Brooklyn, in King's County, and at Rochester, in Monroe County, New York; at Fall River, and in the south-eastern portion of Massachusetts; at Rutland, Vermont; in Pennsylvania, Maryland, District of Columbia, Delaware, and Virginia; in north-western Ohio, in south-eastern Michigan, in Indiana, and Kentucky.

This brood has been well recorded in the East in 1715, 1732, 1749, 1766, 1783, 1800, 1817, 1834, 1851, and 1868.

The other brood (brood VII.), which is a thirteen-year brood, appeared last in 1872, and will occur in the southern portion of Illinois, in Kansas, Missouri, Georgia, Louisiana, Tennessee, and Mississippi.

It will thus be seen that the cicada is to occur over an extended area, the seventeen-year brood covering a wedge-shaped track of country, having its widest border near its northern limit, and thence gradually narrowing toward the south, with its southern point reaching northern Georgia. The thirteen-year brood is located to the south-west of this wedge, and is much more limited in extent. The relative areas of the two broods are indicated in the accompanying map. This gives only the localities which have been fully verified, though there are doubtless many other connecting points between the separated regions.

NOTE.—The visitations of the seventeen-year brood are indicated by dots; of the thirteen-year brood by lines.

The two broods would seem nowhere to overlap and come in contact with each other, as they are separated by the whole extent of northern and central Illinois, and nearly the whole State of Kentucky. They approach each other most in Georgia.

The periodicity in the appearance of this insect is so constant that the naturalist calculates as confidently on its future recurrence in a given month of a given year, for all future time, as the astronomer does on an eclipse or a transit on some particular day. There is something rather pleasant in the feeling that we may go back in mind to some particular day of a particular year in the past history of our continent, long before civilised man had discovered it, and feel perfect confidence that the woods rattled with the hoarse cry of this cicada in the month of June, very much as they are now doing.

The habits of this insect are briefly given by me in the "Western Farmers' Almanack" for 1878, from which I quote:—

"The appellation of 'locust' was bestowed upon it by the early settlers of this country from an erroneous notion that it was identical with one of the 'plagues of Egypt' recorded in Biblical lore. This idea took such forcible possession of the Puritanic mind that the shrilling of these insects was thought to be a prolonged and threatening cry of 'Pha-a-a-raoh!' Its habits being entirely unknown in those early times, its sudden appearance in prodigious numbers at such long intervals naturally caused it to be regarded as a supernatural visitant sent for the twofold purpose of a plague and a warning. Hence the popular superstition construing the two W-like markings on the tips of the upper wings into a prophecy of 'war.' Timid people may rest assured that they portend nothing, unless it be warm weather. The peculiar musical apparatus of the males may be likened to a pair of kettle-drums. These drums are formed of convex plates of parchment-like substance, folded into fine plaits and located in cavities behind the thorax. Muscles are attached internally to these plates, by the contraction and relaxation of which the drum-heads are alternately tightened and loosened, the effect being a

* From *Harper's Weekly*.

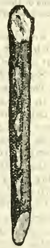
rapid succession of shrill, rattling sounds. The males only possess these musical organs, the females being absolutely mute—a fact which was embodied in the lines of Xenarchus,

> Happy the cicada lives,
> Since they all have voiceless wives.

"The body of the female is provided with a complicated piercer and ovipositor, consisting of a pair of tiny double-edged saws and a spear-pointed borer, which plays between them. When not in use, this instrument is folded into a longitudinal groove on the under surface of the abdomen. Both sexes have a sharp beak, or *haustellum*, with which they pierce the bark of shrubs and trees, and extract the small quantity of sap which constitutes their sole nourishment.

"The periodical cicada emerges from the ground and attains its wings during the latter part of May or early in June, in the latitude of the Middle States, the males usually appearing several days in advance of the females, and perishing proportionally early. Immediately after pairing, the females begin the laborious process of oviposition, the result of which is the severe, and sometimes fatal, summer pruning of our forest and fruit trees. With her ovipositor the female penetrates the twigs of trees, and inserts therein two rows of eggs obliquely

Seventeen-year Cicada (*Cicada Septemdecim*, Linn.), side view of ♀ to show beak, *a*, and ovipositor, *b*. Colours.—Black, brown, and orange.



Twig punctured by the Seventeen-year Cicada.

Twig healed after the puncture.

placed. The eggs are one-twelfth of an inch in length, of a pearl-white colour, and taper at each end to an obtuse point. They hatch in about six weeks, usually before the branch containing them breaks off. The newly-hatched cicada is very active, its motions resembling those of an ant. It soon casts itself fearlessly from the highest tree-tops, its insignificant weight admitting of its being wafted gently downward to the ground. Impelled by instinct, it at once burrows underground in search of rootlets, upon whose exudations and sap it subsists, penetrating deeper and deeper into the earth in following their course. It has many times been found at a depth of from 10 to 12 ft.

"This cicada has many enemies, but none more striking than the large hornet or digger-wasp (*Stizus grandis*), the female of which stings, paralyses, and buries it in a burrow beneath the ground as a future store of food for the young wasp.

"There are always reports, during the prevalence of this cicada, of its stinging people; but the researches of entomologists have shown pretty conclusively that all reports of such stinging are based on misapprehension, and are more likely caused by the hornet in question, which, knocking against a person when flying with her heavy burden, will naturally resent the impediment by using her sting.

"The popular appellation of 'locust,' applied to this cicada, has given rise to a good deal of confusion, and serves to confound it in the popular mind with the destructive locusts, or so-called grasshoppers, which ravage our crops. These belong to the Orthoptera, an order of mandibulate insects. Reports of serious injury by these ravenous pests, which belong to the same family as the locusts of Scripture, already come from the south-east and from California. But the cicada is incapable of any such injury, as it belongs to the Homoptera, a haustellate sub-order, and feeds by suction, so that it can not devour vegetation. The only injury it inflicts is by means of the ovipositor, as the sawing and puncturing of the twigs of trees for oviposition almost invariably causes the tips of the twigs to break off or die. Its injury on young fruit-trees is sometimes very serious."

MYSTERIES AND MORALITIES.

By Edward Clodd.

II.

THE incorporation of heathen festivals and processions into her calendar by the Church of Rome not only indicates that every religion has to depend for it existence upon like agencies, but also that what was thought to be distinctive to one religion is found to be common to all, the difference being always in degree and detail, never in substance. "There is nothing hardly," says the author of the 'Essay to Retrieve the Ancient Celtic,' "that will bear a clearer demonstration than that the primitive Christians, by way of conciliating the Pagans to a better worship, humoured their prejudices by yielding to a conformity of manners, and even of customs, where they did not essentially interfere with the fundamentals of the Gospel doctrine. This was done in order to quiet their possession and to secure their tenure: an admirable expedient, and extremely fit in those barbarous times to prevent the people from returning to their old religion."*

Subsequent inquiry endorses this statement in the main, identifying some of the principal Christian festivals with their pagan prototypes, as, *e.g.*, Christmas Day with the day of the winter solstice in the Roman calendar, and of the celebration of the birth of the sun-god Mithra, an imported Vedic deity; Easter Day with the worship of the Teutonic nature-god Eastre; † and May Day, also the *festa* of the Virgin, with the Floralia of the Romans, but stripped of their licentious merriment. The venerable Bæda, in his "Ecclesiastical History of England," cites a letter from Gregory the Great in the sixth century to the Abbot Mellitus, then on his way to this island, in which he bids him tell Augustine, the first Archbishop of Canterbury, that the temples in Britain should not be destroyed, but sprinkled with

* Quoted in Brand's *Pop. Ant.* I., 136.

† Ostara, or Eastre, seems to have been the divinity of the dawn, and perhaps of the spring, and the festival in her honour "could," as Grimm says, "be easily adapted to the festival of the Resurrection."—T. M., pp. 290–1.

holy water, and relics placed in them, the idols being shattered. Also that the sacrifices should be continued, only the objects offered being changed, and that permission be given to build huts of boughs about the transformed temples on the day of the dedication or of the birth of the martyrs whose relics are deposited therein. Concerning the more popular entertainments with which the Church humoured the multitude, as before her the Empire had appeased the hunger of the Romans for "*panem et circenses*,"—"bread and games", we find, prior to the acting of Miracle Plays and Mysteries in thoroughfares, and as surviving among them here and there long after their introduction, frequent reference to mock festivals and grotesque processions, probably of Saturnalian origin, as, among others, the Feast of Fools, the Feast of Asses, and the Boy-Bishop. At the Feast of Fools a sham pope was elected, amidst gross and wanton burlesque of the pontifical office. The priests forming his suite dressed themselves as players in a pantomime, blackened their faces, sang lewd songs, danced with indecent gestures round the altar, on which they played with dice and burned old shoes for incense. At the Feast of the Ass, said to be instituted in honour of Balaam's reproving ass, but really a variant of the Feast of Fools, and more often commemorating the flight of the Holy Family into Egypt, the fairest maiden and prettiest infant in the place where the feast was held were mounted on an ass, and led at the head of a gay procession to the church, where service was performed, the several parts of which were ended with the imitation of a donkey's braying, instead of with the *Gloria Patri*, &c.; and at the conclusion, as the ass was led to the choir, a hymn of nine stanzas sung, of which the following is a specimen verse:—

	(*Free translation.*)
Orientus partibus	From the regions of the East—
Adventavit Asinus	Blessings on the bonny beast!—
Pulcher et fortissimus	Came the Donkey, stout and strong,
Sarcinis aptissimus	With our packs to pace along,
Hé, Sire Ane, hé.	*Bray, Sir Donkey, Bray!*

As at the Saturnalia of the ancients, when distinctions were for the time being effaced, and masters and slaves changed places, the church menials were wont at the Feast of the Innocents to perform the priestly offices in extravagant parody. The same day witnessed the end of the authority of the Boy Bishop, elected on the anniversary of St. Nicholas, patron saint of children, by the choir-boys of cathedrals, which were given up to this mock episcopal sovereignty.

But enough has been cited respecting this class of amusement to illustrate the flexible adaptability of the Church to human nature; her utilisation of that which she could not abolish, or which, repressed, would only have broken loose in more extravagant form, and in rebellion against her authority. Such illustrations, however, are of value in disclosing the ecclesiastical framework and colouring of all popular recreations, as well as of the more serious dramatic presentment which to a large extent supplanted them. In connection with this some reference should be made to an interesting argument adduced by Klein, Ward, and others, that "the germ of the miracle-play as an acted drama is to be found in the liturgy of the Mass, the symbolic processes in which exhibit a dramatic progression." * Without doubt, as the calendar was more amplified, the services of the Church, and especially those connected with such important seasons as Christmas and Easter, became more dramatic in character. In the Liturgy of the Mass, in the pantomimical element in the gestures of the priest, the epical in the lessons read, the lyrical in the antiphonal singing, and subsequently in the additions as early as the fifth century of *tableaux vivants*, living pictures of scenes from New Testament history, the way was made ready for the public performance of sacred plays by clerical actors. The date of the connection of the epical portion of the liturgy with the spectacular and lyrical is uncertain; but a writer of the tenth century says:—"It was customary on Christmas-day, after the *Te Deum*, to perform the office of the Shepherds, others of the same kind, such as that of the Innocents of Bethlehem, the Star, the Sepulchre, being celebrated each in its season."* Thus these offices were a visible repetition of the gospel of the day, in which, as a matter of course, priests were the actors and the church the scene. Remembering how entirely the Church usurped to herself the functions of instructress of the masses, how, indeed, but for her they would have remained ignorant, and how similar are the instruments of the ritualist and the actor, there is great force in the argument of the writers alluded to, that the Miracle-play as a spectacle is the lineal descendant of the liturgical mystery, the didactic element being, as shown already, the survival of the ancient metrical paraphrases of scripture. Hence the genealogy of the secular drama is as follows:—

Liturgical Mystery
|
Miracle Play
|
Mystery — Morality
Interlude — Chronicle History †
Comedy — Tragedy

Although the performance of the sacred plays long remained in the hands of the clergy, we find them frequently acted in London, before king and court, by the parish clerks, who were incorporated into a guild in the reign of Henry III. But the central interest of these plays gathers round their performance by the trading guilds or fellowships in the large provincial cities, as at Chester at Whitsuntide, and at York, Leeds, Coventry, and Newcastle, on the feast of Corpus Christi.

This, the most magnificent festival of the Roman Catholic Church, was instituted in 1264 by Urban I. in honour of the consecrated Host, and the high importance accorded to it led the guilds to regard it as a common feast day, and to select it for the exhibition by each company of its own appropriate play in the series of Mysteries, which began with the Creation and ended with Doomsday. The plays were originally the work of monkish pens, but lay writers were employed here and there in the alteration and adaptation of them to the requirements of the trading fraternities, who entrusted both plays and properties, choice of actors, "good players, well arayed, and openly spekyng," as well as the rehearsals, to an official. The actors were paid according to the length of their parts and quantity of business in them, not according to their dignity. Thus, in a play setting forth the trial and crucifixion of Jesus, the impersonators of Herod and Caiaphas received 3s. 4d. each; of Annas, 2s. 2d.; and of Jesus, 2s., which was also the sum paid to each actor in the parts of his executioners. The Devil

* Cf. Prof. Ward's valuable "Eng. Dramatic Lit.," Vol. I. pp. 19-22.

* Quoted in Ward, Vol. I., p. 21.

† Concrete examples from history taking the place of impersonated ideas.

and Judas were paid less, as these extracts from the pageant accounts show :—

Payd to the players for rehearsal—Imprimis, to God, 2s. 8d.; itm. to Pilate his wife, 2s.; itm. to the Devil and Judas, 1s. 6d.

Peter was paid 16d.; the two damsels, 12d.; while one Fanston, for the commendable duty of hanging Judas, receives but 5d.; and, ubiquitous genius as he seems to have been, "for coccroying, iiijd."*

The clerical vestments had been originally borrowed or hired from the churches for the use of the actors of sacerdotal characters like Caiaphas and Annas, a practice which was censured by the stricter clergy (notably by the Bishop of Winchester in 1384, as sacrilege), who at last refused to lend their vestments for that purpose, so that the guilds were obliged to provide the costumes and other properties at much outlay. "To all the city," says an old proclamation, "follows labour and cost." In Sharp's "Dissertation on the Coventry Mysteries" (1825), from which the foregoing extracts from the registers of the trading companies are quoted, we find the following items of cost of repair and wardrobe :—

"For mending of Dame Procula's garments, 7d." [Dame Procula was Pilate's wife]. "To reward to Mrs. Grimsby for lending of her gear for Pilate's wife, 12d," "For a quart of wine for hiring Procula's gown, 2d." "Payd for a pair of gloves for God [all the characters wore gloves]; for gilding God's coat." "Dyvers necessaries for the trimmynge of the Father of Heaven,"

are other items which occur. Under outlay for scenic effects we read :—

"Payd for mending of hell 2d; itm. for painting of hell-mouthe, 3d; itm. for making of hell-mouthe new, 1s 9d; itm. for keeping fyre at hell's mouthe, 4d; itm. for setting the world of fyre, 5d; [which duty was assigned to Fauston of "coc-croying" fame]; itm. to Crowe for making of three worlds, 2s."

Christ was represented as wearing a gilt peruke or beard, and a painted sheep-skin coat, a girdle, and red sandals. His tormentors wore black buckram jackets with nails and dice upon them. The Virgin Mary wore a crown; the angels had white surplices and wings, the souls of the saved wore white coats, and the souls of the lost wore coats of yellow, black, and red, which last colour was given to the hair of Judas Iscariot and the beard of the devil. The faces of all the actors were either painted or covered with masks. Herod wore a gilt and silvered helmet, and was dressed like a Saracen, not an unusual anachronism, as we shall see presently—not more so, at least, than the rosary round the neck of the Virgin, or the pictures of the Prodigal Son, in which that first century "masher" is represented in eighteenth century costume, attended by a negro servant carrying his trunk. The devil had wings and a leather dress, trimmed with feathers and hair, and ending with representations of claws for the hands and feet. That extra pains were bestowed upon the head-gear is shown in the entry of payment to "Wattis for dressing the devil's head." The intended exhibition was announced by proclamation or *bane* (a word retained in our marriage *bans*), made by three heralds (*vexillatores*) with sound of trumpet and lengthy prologue ending to this effect, as in the Coventry series :—

A Sunday next, yf that we may,
At vj of the belle we gynne oure play,
In N.towne,† wherefore we pray
That God may be youre spede. Amen.

* "*Et cantabit gallus.* And than Jhesus xal (shall) lokyn on Petyr, and Petyr xal wepyn, and than he xal gon out and seyn," &c.—"The Trial of Christ," *Coventry Mysteries*, 297.

† The letter N represents a space to be filled in with the name of the town where the performance was to take place.

Archdeacon Rogers, who saw the plays acted at Chester in 1594 according to old usages, thus succinctly describes the mode of exhibition :—

The manner of these playes were, every company had his pagiant, which pagiants weare a high scafold with two roomes, a higher and a lower, upon four wheels. In the lower they apparelled themselves, and in the higher roome they played, beinge all open on the tope, that all behoulders might heare and see them. The places where they played them was in every streete. They began first at the Abay gates, and when the first pagiant was played it was wheeled to the highe crosse before the Mayor, and soe to every streete, and soe every streete had a pagiant playing before them at one time, till all the pagiantes for the day appointed weare playen, and when one pagiant was neere ended, worde was broughte from streete to streete, that soe they might come in place thereof, exceedinge orderlye, and all the streetes have their pagiantes afore them all at one time playeinge together; to see w'ch playes was greate resorte, and also scafoldes and stages made in the streetes in those places where they determined to playe theire pagiantes.

The term *pageant*, it may be remarked, is derived from the movable vehicle on which the plays were performed.

THE RUDDY ECLIPSE OF THE MOON.

By Richard A. Proctor.

I AM sorry that I misunderstood Mr. Mattieu Williams's red-hot moon theory. I cannot even now see that there is much more "monstrous absurdity" in the idea of primeval heat making the moon red-hot than in the idea of solar heat warming up the moon to redness. Has Mr. Williams ever tried the experiment of heating a tufaceous surface to redness? It strikes me that if he had he would hardly imagine that the action of the solar rays could produce such a result, even without the exceedingly rapid radiation which he admits would go on all the time.

However, it appears that it is not primeval heat, as I feared, which he attributes to Dian's cold pale orb. So we are at least in agreement on one point. I am also in tolerable agreement with him about the absurdity of being "so cocksure" as some are, *to-day*, about the nebular hypothesis. (By the way, a correspondent seemed to doubt, a short time since, in the columns of Knowledge, that Shakespeare had used the term "cocksure." I thought every one had read the scene between Gadshill and the Chamberlain, at Rochester, where Gadshill says, "We steal in a castle, cocksure.") Surely, as Mr. Williams points out, knowledge has fairly defined limits; beyond these is the region of speculative folly." But why call this "the blessed abode of transcendental mathematicians"? Surely there have been other originators of speculative folly than mathematicians of the transcendental type. The twenty paradoxists whom *I* should select as the wildest I know of, are not (or were not—for some are dead) mathematicians at all. I doubt even if nineteen-twentieths of my friend's "Fuel of the Sun" must not be regarded as outside the fairly-defined limits of the field of knowledge. Or rather I am not doubtful on the subject at all. As to the theory of young, middle-aged, and senile worlds, though it is one which I rather like, because it is based on reasoning and on certain known physical laws in regard to radiation and conduction (laws which Mr. Williams ignores in opposing that theory) I am not so enamoured of it but that I always present it as serving chiefly the purpose of a thread, on which astronomical facts,—including by the way every *fact* presented in Mr. Williams's "Fuel of the Sun"—may be conveniently strung. That those facts

do run so readily on the thread of theory seems to show that I have got hold of a sound and well-spun thread. But I care much more for the beads of fact than for the thread of theory.

But now, with regard to actual facts. That ruddy colour in our skies,—should it have led us to expect a ruddy moon or not, according to the accepted explanation of the origin of the ruddy light? (Mr. Williams speaks of *my* theory; but I have never advanced a theory of my own about a matter already thoroughly well explained by others. There is indeed no *theory* about the ruddy eclipsed moon, any more than there is about 2 and 2 making 4.) Mr. Williams, when he supposed that the accepted explanation ascribed the moon's red light to the illumination of our air by the sun's rays, was quite right in inferring that the eclipsed moon ought to have been very red on Oct. 4, and on March 30. But now that I have shown how the accepted explanation really accounts for the moon's ruddiness in total eclipse, he no longer is justified in saying that the moon should have looked red on those occasions. For, every one who has given the least attention to the observed phenomena of the coloured sunsets, knows that let their cause have been what it may (the Krakatoa explosion is unquestionably exploded) the ruddy light was not due to transmitted but to reflected and dispersed rays. If then our atmosphere, to great heights, had the power of intercepting red rays (reflexion and scattering imply so much) how on earth could the red rays get to the moon?—as, under ordinary conditions, they would, and do.

I am not concerned to show that the self-luminous tufaceous surface of Mr. Williams's theory would send its light through an atmosphere in such a state; for I am in no degree interested in that theory, which seems to me not so much to lie outside knowledge, as to be utterly inconsistent with known facts.

Turning to another point—the difference between the behaviour of a pencil of rays in passing to a focus and the course of the axis of a pencil, is somewhat more important than Mr. Williams imagines. For instance, failing to recognise this difference, Mr. Williams has been led to imagine that the focus of a pencil of rays proceeding from a point on the sun's surface to the earth's atmosphere, thence to pass towards the prolongation of the line joining the centres of the sun and earth, must lie *somewhere on this line*. I am quite sure that nothing in the treatment of optical problems when Mr. Williams was a lad would have encouraged this mistake. As a mere matter of fact, the focus (or rather the primary and secondary foci) of such a pencil, *cannot lie within many millions of miles* of that point on the line in question to which the axis of the pencil is deflected by the action of the earth's atmosphere: *it cannot even lie between the earth and the moon at all.*

Not to mention several other points, Mr. Williams does not appear to have noticed that regarding the layers of air which deflect the sun's rays during the time of solar eclipse, as forming part of a spherically convex lens, the incidence of those rays is *exceedingly oblique*. Can he recall any of the formulæ relating to the construction of optical instruments wherein it is not an express condition that the obliquity of incidence should be so small that it may be either neglected or readily corrected?

I can take two similar prisms and by means of them make the axes of two pencils of rays from a luminous point intersect each other. Is that point of intersection the focus for those rays? On the contrary, each pencil after emergence has its own pair of *foci* and its own "*circle of least confusion*," none of the six lying *anywhere near* the point of intersection of the *axes* of the two pencils. (The more nearly parallel the rays forming the pencils severally are the farther away are their foci from the point of intersection of their axes.) This corresponds precisely with the action of two parts of the atmospheric zone at work during total lunar eclipse, on opposite sides of the earth.

Turning to Mr. Ranyard's letter, I find myself perplexed. He cannot really, I should suppose, misunderstand matters as he seems to do. Yet I have read and re-read and re-re-read his letter, without finding any escape from the conclusion that he has in some way or other gone altogether astray.

For instance, it looks as though he supposed that during the progress of totality, and near the time of mid-totality, layers of our air many miles above the earth's surface are at work in refracting solar rays upon the moon's surface, while layers reaching far above the two miles which he sets as the highest reasonable limit of cloud-layers obstructing the transmitted rays (or rays which but for them would be transmitted) *may* exercise so great an absorptive action as to prevent sunlight from passing through at all.

Be his views what they may, it is certain at any rate that everything in what I have just described as apparently Mr. Ranyard's meaning, is decidedly inconsistent with known optical and physical laws.

Take first the refractive power of the higher layers of our air:—I would not for a moment insist on taking Bradley's empirical law as satisfactory for exact inquiries; but unless this law, which is found to be true for barometric variations of considerable extent, fails *entirely* at high levels, it is certain that the air above 3½ miles, where the barometer stands at a height of only 15 inches, can send *no light whatever* to the moon at the time of mid-totality.

Secondly, it is absolutely certain that air not so cloud-laden or so dustladen, or thick enough, from whatever cause, to render the sun's light faint to us when he is setting, must transmit a considerable amount of light to the moon even in the case of rays grazing the earth,—while rays passing a mile or two from the earth's surface would be absorbed in much less degree, and rays passing ten or twelve miles from the earth's surface would be scarcely absorbed at all.

Thirdly, when there are clouds in the air, those at a height of six or seven or even ten miles, may readily obstruct large quantities of light passing very obliquely athwart their layers. Even when there are only cirrus clouds in the sky, it will often happen that while these clouds are so sparse overhead that they seem to obstruct scarcely any light, they form an impenetrable veil near the horizon.

But the strangest point in my friend's letter is his singular misapprehension—as I understand him—of that imaginary increase of the earth's diameter by 1-60th part which Tob. Mayer was the first to recognise as necessary in dealing with the umbra. Of course he quite rightly recognises the effect of the sun's decrease of lustre towards the edge in increasing the effective extent of the umbra. But the relatively sudden diminution of lustre as the geometrical shadow is approached, and the general uniformity of the tint afterwards need no such explanation as he has devised. Let the refractive effect of our earth's atmosphere do what it may in diminishing the extent of the region in absolute shadow, it can never do more than throw a very feeble light within the geometrical shadow. Moreover, the light thus thrown by

the lower three or four miles of the air must be tolerably uniform (apart from clouds breaking the ring of sunlight).

(*To be continued.*)

THE YOUNG ELECTRICIAN.

By W. Slingo.

TWO ELECTRIC STATES.

Pr. 3.—There are two electric states, usually called positive and negative. These terms are useful and serve their purpose very well; although, perhaps, others a little better might have been chosen. We can use them independently of any views we may hold on the single, double, or no-fluid theories of electricity. As electricity is but a condition of matter, we can scarcely hope to get beyond the bounds of assumption. It is simply a theory, and not an established law or principle, to say that there are one, or two, or any number of electric fluids: what evidence there is is decidedly the other way—that is to say, electricity is a force which is not a fluid, nor does it in many cases behave like a fluid. As, however, we have set ourselves against theorising, let us simply re-assert that there are two electric states or conditions, and let us endeavour to identify them.

Ex. XCI.—Attach the thread or ribbon connected to the paper loop (Fig. 39), or the wire stirrup (Fig. 41), to

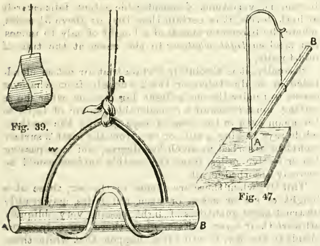


Fig. 39. Fig. 41. Fig. 47.

a support of some kind, such as that illustrated in Fig. 36 (page 495). Fig. 47 shows the arrangement. Any other form of support, however, that suggests itself to the young electrician will do for this purpose, as insulation is not essential. We know (from Ex. LXXIV.) that if an unelectrified stick of sealing-wax, &c., be placed on the stirrup, the approach of an electrified rod results in attraction. Similarly (Ex. LXXIX.) the unelectrified sealing-wax is attracted by an electrified glass tube. So also would the electrified sealing-wax or glass attract an unelectrified glass tube placed in the stirrup. Let, now, the end B of a stick of sealing-wax, say seven or eight inches long, be rubbed with a piece of warm, dry flannel, and placed on the stirrup. Then bring near the end A, another electrified stick of sealing-wax, attraction will ensue; but bring the second stick near the end B, and instead of attraction we shall get repulsion, for the suspended rod will recede from that held in the hand. Lay the second stick on one side in a dry place, and electrify the hot dry glass tube (Ex. LXXIX.). Then bring it near A, attraction takes place, and if the glass be brought near B we get even stronger attraction (instead of repulsion, as with the sealing-wax). Now substitute for the suspended sealing-wax a piece of dry warm glass tubing, say half-an-inch in diameter, and ten or twelve inches long (with—if you have it—one end sealed). The electrified sealing-wax or glass held in the hand will attract either end A or B of the unelectrified glass. But if the end B of the glass be electrified in the usual manner, strong attraction will be exerted between it and the sealing-wax, while it will recede from or be repelled by the electrified glass.

Here, then, we see that electrified sealing-wax attracts electrified glass but repels electrified sealing-wax, and conversely electrified glass attracts electrified sealing-wax and repels electrified glass: clear evidence that there are two electric states, that the states produced on similar bodies by similar rubbers are mutually repellant, while the states produced on dissimilar bodies by dissimilar rubbers produce (although not always necessarily) attraction.

Ex. XCII.—That either electric state is self-repellant may be further demonstrated by a modification of Ex. LXXXV. Draw a piece of narrow silk ribbon between two adjacent fingers provided with india-rubber stalls, and then carefully suspend the ribbon over one of the fingers held out straight, the two halves of the ribbon, being similarly electrified, will repel one another, and take up positions as shown in Fig. 48. The stronger the electrification the greater, of course, will be the divergence of the ribbon.

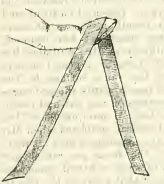


Fig. 48.

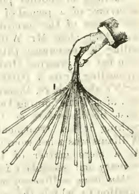


Fig. 49.

Ex. XCIII.—Another interesting experiment may be performed with the sheet of electrified note-paper (Ex. LXXXIII). Having electrified it by rubbing it while laying on a hot, dry board with a piece of india-rubber, cut it into a kind of fringe, but drawing a sharp knife through it several times, making the cuts parallel, and letting them extend nearly the length of the paper. Half an inch, or thereabouts, may be left uncut, that is, sufficient to hold the strips together. Now raise the paper carefully from the board, and fold up what we may call the top of it so as to leave the strips free and hanging downwards. It will be observed that the strips will exhibit decided evidence of being similarly electrified by the energy with which they mutually repel one another, taking up the positions indicated in Fig. 49.

Ex. XCIV.—A very attractive experiment is that illus-

trated in Fig. 50. A stand consisting of a stick of wood, 18 in. or 20 in. long, stuck into a suitable piece of flat wood, say 7 in. or 8 in. in diameter, is provided with a funnel support. This may be arranged in a

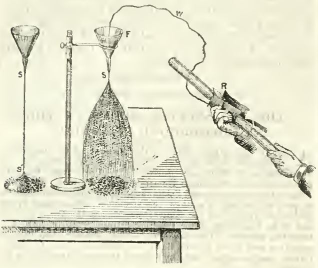


Fig. 50.

variety of more or less simple ways. The simplest, perhaps, is a piece of stout wire, bent approximately into a circular loop, and twisted securely round the upper portion of the wooden rod. If the rod is round, a more elegant contrivance may be easily constructed by procuring a piece of brass tubing about 2 in. long, having an internal diameter *slightly* less than the thickness of the rod. Slit this tube along one side and solder on to it, near the top or bottom, a piece of stout wire bent to shape, or a piece of sheet tinned iron with two holes cut in it, one to carry the funnel, the other to slide over the rod. The brass tube, if of the proper diameter, will fit spring-tight on to the rod, and so enable it to be placed at any height. If it is desired to secure the tube by means of an ordinary screw, or, better still, of a thumb or milled-head screw, then a stout piece of tubing will be required, or a solid piece of metal may be soldered to the tubing, and have a hole drilled through it and tapped for the screw. When a square rod is employed, and it is not thought necessary to provide means for altering the height of the looped arm or carrier, a suitably-shaped piece of tinned iron may be employed, cutting a hole in one end of it for the funnel, and bending the other end at right angles, the bent portion being securely tacked on to the wooden upright. A number of other ways for accomplishing this will doubtless suggest themselves. In the loop or hole place a small glass-funnel, F (procurable at a chemical apparatus maker's), provided with an aperture of about $\frac{1}{8}$ in. in diameter; partly fill it with fine silver sand, and the sand will fall through in a straight column like that indicated on the left side of the support. If, however, one end of a wire, W, be immersed in the sand, while the other end is connected with a glass tube or other body being electrified, the sand will be electrified and self-repellant, when, instead of falling, as previously, in a straight column, it will be constrained to fall after the manner shown in the figure. To ensure success with this experiment a modification of the rubber is necessary. With this we will deal next time.

OUR HOUSEHOLD INSECTS.

By E. A. BUTLER.

COLEOPTERA (*continued*).

IN order to find the other household members of the Heteromera, we must leave for a time the cellars in which we were hunting for our first representative of the group—the foul churchyard beetle—and visit localities of an altogether different description, viz., bakers' shops, bakehouses, flour-mills, and granaries. Farinaceous substances, such as wheat, barley, maize, meal, flour, bread, cakes, &c., are specially liable to the attacks of various species of beetles, belonging, curiously enough, to several totally distinct sections of the order. In stores of corn in granaries, no less than eighteen species of beetles have been found amongst the refuse, though it is probable that several of these were there, not to eat the grain themselves, but to prey upon such of their associates as were addicted to that practice. Still, it is certain that there is a gang of nearly a dozen species that will engage in this work of destruction whenever they can get a chance, and the ringleaders are those two great sinners, the corn weevils, which we described on a former occasion (See KNOWLEDGE, March 28, 1884). Our old friend, the omnivorous *Niptus*, too, sometimes joins the ranks of these "corn-lovers," and Dr. Power records having found it in hundreds in a quantity of meal, which he transferred to a closely-stoppered bottle, where, notwithstanding that the bottle was never opened, the insects continued to breed for three years, though in gradually decreasing numbers.

But our concern at present is with the Heteromerous members of this gang of freebooters. They are chiefly of small size, and none of them equal *Blaps* in stature. By far the largest are those whose larvæ constitute the well-known "meal-worms," belonging to the genus *Tenebrio*, from which the whole family is named the *Tenebrionidæ*. The meal-worms themselves we reserve for a future notice, and turn our attention at present to the smaller species.

First, we have two very closely allied insects, called *Tribolium ferrugineum* and *T. confusum*, the former of which (Fig. 1) is much the commoner. They occupy a position very inferior to the corn-weevils in point of destructiveness, but still they are an enemy not to be despised. They are both small dark reddish-brown insects—a colour referred to in the name *ferrugineum*, "rusty"—of insignificant appearance, and, like several others of the group, do not rightfully belong to the British fauna, having been introduced here with foreign merchandise. They have, however, established themselves, at least under the shelter of human roofs, where they will breed freely, and therefore, though they do not yet appear to have become naturalised in the truly wild condition, they are usually included in lists of British insects.

They are so much alike, that to a casual observer they would appear identical. By a very close and careful comparison under the microscope, minute points of difference in the antennæ, thorax, and punctuation can be made out, but these are of too minute and technical a character to be rendered intelligible here. In the name *confusum*, the "confused," given to the second species, we have an indication of the difficulty that attends their separation, and of the probability of their being confounded together. There is one peculiarity, however, possessed in common by these insects and their allies which is worth notice. It is that the eyes, which look like piles of tiny, polished black beads, are much encroached upon by a projecting

ridge in front of the head, which is produced backwards in such a way as to appear to have grown partially across the eyes, almost entirely dividing each mass into two unequal parts, one above, the other beneath.

The larvæ of these insects are tolerably active, somewhat hairy creatures with six short legs in front. In common with larvæ generally they change their skin several times, each time making their exit from the slough through a slit along the back of the neck, dragging out therefrom, first the segments that afterwards become the thorax, then the head and legs, and finally the abdomen. Previously to assuming the pupal form, they become restless, and search about for a suitable place of lodgment; having found one to its taste, the grub arches its back and divests itself of its last larval skin, and then passes very rapidly through the resting stage of pupadom, appearing in an incredibly short time as a perfect insect, ready again to take part in the activities of life. At first it is pale, and the elytra are so transparent that the body can be seen through them; after a few days, however, they acquire their characteristic ferruginous colour and opacity. The pupa shows distinctly all the parts of the perfect insect, the head, wings, and legs being bent down underneath the body.

Fig. 1.—Tribolium ferrugineum.

Fig. 2.—Head of Gnathocerus cornutus (much magnified).

These insects do not confine their attentions to farinaceous substances; they are also animal feeders, and are amongst the enemies to be dreaded by the keeper of collections of natural objects; their larvæ will excavate the carcase of a dried insect as effectually as will those of *Dermestes* or *Anthrenus*.

Another bakehouse insect is *Gnathocerus cornutus*, which is identical in colour with *Tribolium*, and very similar in shape, but somewhat larger. Its names, *Gnathocerus*, "jaw-horn," and *cornutus*, "horned," both refer to a peculiarity of the male only, by which that sex can be easily distinguished from all other members of this group. The mandibles, *i.e.*, the biting jaws, are each in the form of a long horn, the pair of which, projecting considerably in front of the head, and curling upwards, give the insect a most formidable aspect. The head is altogether an odd-looking object (Fig. 2), for, besides these mandibular horns, there are two blunt horns on the forehead, and the ridge that almost divides the eyes is produced into a kind of flap or scoop on each side.

By these remarkable structures we are reminded of what seems almost like a law in the insect world, viz., that of all the different parts that make up the whole organism of a typical insect, there are some, such, for example, as the legs, that preserve a very great uniformity of type throughout the class, varying in the different groups, and through the thousands upon thousands of species, only within comparatively narrow limits, while others seem possessed of much greater plasticity, so to speak, and run off occasionally into such eccentricities, extravagances, and apparent monstrosities, that it seems as though there were no limit to the modifications of which they are capable. Perhaps the best illustrations of this are to be found in the thorax and antennæ, in both of which most marvellous and unexpected developments, both in shape and size, are to be met with. And in our present insect we see the head and mandibles partaking of this same tendency to fantastical modification, a tendency which, so far as mandibles are concerned, is manifested in a most remarkable degree also in the stag-beetle, the "horns" of which are really its jaws. And in that case, too, as in the present, it is in the male sex that the structural peculiarity is found.

(To be continued.)

THE DEEP-SEATED ROCKS IN THE NEIGHBOURHOOD OF LONDON.

AMONG the papers read at the meeting of the Geological Society on June 24, were "Supplementary Notes on the Deep Boring at Richmond, Surrey." By Prof. John W. Judd, F.R.S., Sec.G.S., and Collett Homersham, Esq., F.G.S.

Since the author's former communication to the Society on the subject, this boring, in spite of the strenuous efforts made by the Richmond Vestry and the contractors, Messrs. Docwra & Co., has had to be abandoned, after reaching a total depth of 1,447 feet from the surface. This depth is 145 feet greater than that of any other well in the London Basin, and, reckoning from Ordnance Datum, reaches a lower level by 312 feet than any other well in the district.

Before the termination of the work temperature-observations were obtained, which, generally, confirm those previously arrived at.

The strata in which the boring terminated consisted of the red and variegated sandstones and marls previously described, which were proved to the depth of 208 feet. Although it was demonstrated that these beds have a dip of about 30 deg., complicated in places by much false-bedding, no conclusive evidence could be obtained concerning their geological age. They may be referred either to some part of the Poikilitic series, or to the Carboniferous (for similar strata have been found intercalated in the Carboniferous series at Gayton, near Northampton), or they may be regarded as of Old Red Sandstone age.

Some interesting additional observations have been made since the reading of the former paper, on the Cretaceous rocks passed through in this well. Mr. W. Hill, F.G.S., of Hitchin, has found the exact analogue of the curious conglomerated chalk met with at a depth of 704 feet at Richmond. His observations entirely confirm the conclusion that we have at this depth the "Melbourne Rock" with the zone of *Belemnites plenus* in a *remanié* condition at its base. Some new facts concerning the state of preservation of the fossils in the Chalk Marl are also recorded.

With respect to the conclusions arrived at by the author concerning the distribution of the Jurassic rocks on the south side of the London Basin, an important piece of confirmatory evidence has been supplied by a deep boring made at the Dockyard-Extension Works at Chatham. This section, for the details of which the authors are indebted to the officers of the Geological Survey, shows that under the Chalk and Gault, with normal characters and thickness, there lie 41 feet of sandy strata of Neocomian age, and that these are directly underlain by blue clays of Middle Oxfordian age, as is proved by the numerous fossils which they have yielded. We have now, therefore, direct evidence of the existence and position of strata of Lower, Middle, and Upper Oolite age, respectively, beneath the Cretaceous rocks of the south-east of England.

IT is said that the applications for space and concessions at the American Exhibition to be opened at Earl's Court, London, on May 1, 1886, are arriving in great numbers.

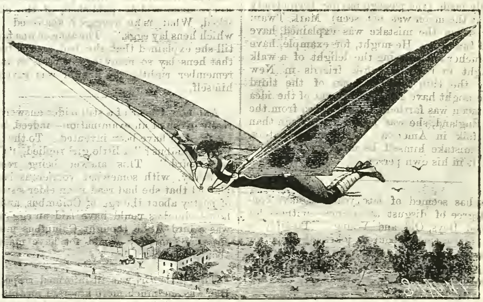
PEPPERING SPARROWS.—A trouble arises to those who train ivy and other vines on the sides of their dwellings from the noisy sparrows, who make their homes and build their nests in the branches, and chatter and quarrel to the annoyance of their inmates. The writer, after trying many expedients for getting rid of his tormentors, was most successful in the use of shot. A handful flung into the vines had the effect, after a few applications, of driving the chattering throng away, but they returned in less numbers in a few days. But another has tried a plan which we should think would be more effective. He scatters red pepper from a window above into the vines, and he says the birds evinced their dislike to cayenne by taking their departure, and that he has been comparatively free from their annoyance since.

A NEW FLYING-MACHINE.*

THE easy and graceful flight of birds through the air has for the last hundred years been a problem occupying the acutest minds. Attempts have been made during the same period to imitate the motion of the bird in ethereal space, either by the aid of the application of the balloon or by the use of the muscles of the human body alone. Attempts in this direction, although none have as yet been crowned with success, are praiseworthy, and doubtless will in time achieve a fair degree of success. The accompanying engraving represents a flying-machine, which is the invention of Dr. H. P. Booth, of Chippewa Falls, Wisconsin. The fundamental principle of this flying-machine is in using simultaneously every important muscle of the body for the purpose of elevating the body and propelling it forward through the air.

In harness a man has lifted 3,500 pounds, and this wonderful result is achieved only by allowing every muscle to act simultaneously to its fullest capacity, and under the most advantageous circumstances. This flying machine is merely a harness, by which the human body acts to its best advantage, to the end that it may be both lifted and propelled; and if flying by muscular force alone is ever accomplished, it must be by using all the power there is in the human frame. In this machine there are two wings, each of which is from 12 ft. to 15 ft. long, and the breadth equal to the length of the operator, from his shoulders to his feet. The frame of the wings consists of three bamboo poles lashed together, and bent to suitable shape, and covered with silk. A cord extends from one extremity to the other of each of these wings (that is, from the heel to the tip), which serves to give the wing proper shape and tension, being covered by the silk of the wing.

The wings are provided with suitable valves, which open on the upward and close on the downward movement. The frame of the wings forms a right angle in front of the shoulders, and below the breast of the operator, as shown in the engraving, and to these is attached two strong ropes of raw hide. Each of these ropes passes from the wing to which it is attached to the shoulder of the operator, who is supplied with a suitable collar, which supports the frames of the wings loosely, and runs along the back, forming a pair of loops for the feet to pass through. When the body is forcibly straightened, the wings are brought down with all the power of the most powerful muscles of the body, as is shown in the engraving, and this movement is also assisted by the strong muscles of the arms, operating the wings from the under side. Over the shoulders, extending from one wing to the other, is a strong rubber spring, the tendency of which is to lift the wings, thus assisting the arms in the upward movement. If desired, the hands, instead of operating the wings from the under side, may grasp the short lever forming the base of the wing, and thus make use of more powerful muscles of the arm than if the arms are extended. Which of these is best is, of course, a matter to be determined by experiment. Each wing may be operated independently of the other, it being only necessary to operate one foot or the other to give each wing just such a movement as may be desired. A canvas extends from the base of one wing to the other, forming a sort of stretcher, upon which the operator rests. From the lowest point of the base of the wings are



several small stay ropes running to different points of the wings, which serve to stiffen and strengthen them. In this device the body of the operator offers the least possible resistance to the air, he being in precisely the same attitude that a bird is in during flight. The parts of the apparatus are constructed of the lightest as well as the strongest materials.

* From the *Scientific American*.

SIXPENNY TELEGRAMS.—As we anticipated, sufficient interest in the New Telegraph Acts Amendment Bill has been excited to forbid its summary dismissal. Lord John Manners' statement in the House on Monday evening has met with a very favourable reception, and we may take it for granted that no time will be lost in introducing the reform. Prophesying is dangerous unless you know, but it is safe to express an opinion that we shall be able to use the wires at the reduced rate in October next.

THE country spent a very large sum of money on the *Challenger* expedition, and now that the narrative has been published, it has been done under the red-tape rule for dry-as-dust reports, and to cover the cost of production no less than £6. 16s. 6d. is being charged on the 750 copies published. Here is a book, the materials for which were obtained at public expense, being published at a price which precludes 99 per cent. of those who would like it from even a hope of getting it. Government encouragement of scientific research will not gain much public favour this way.—*The Engineer.*

Gossip.

BY RICHARD A. PROCTOR.

IN an article which I once wrote on "Finding the Way at Sea," I poked a little fun at Mark Twain's odd mistake about the moon at sea. It will be remembered that the mistake was on this wise :—Because the ship, travelling eastwards, made the sun rise (and also set and "south") about twenty minutes *earlier* day after day, and because the moon rises (and also sets and "souths") about twenty minutes *later* day after day,—therefore the moon remained unchanged to him and his fellow-passengers as they travelled eastwards : "To us Joshuas," as he puts it, "she was a full moon all the time,"—which of course is absurd. Some one answered in an American paper that it was absurd of me to take Mark Twain in earnest. But this was to insult Mark Twain as a humourist ; of course his joke was limited to the introduction of Joshua. If Mr. Blucher had made the mistake about the moon, in anticipation, which Mr. Clemens actually made (the passage having been cloudy I suspect, so that the moon was not seen), Mark Twain might probably, when the mistake was explained, have made very good fun of it. He might, for example, have pictured Mr. Blucher anticipating the delight of a walk by full moonlight in England while friends in New York had only the thin waning moon of the third quarter. Or he might have got good fun out of the idea that while the moon was farther than the earth from the sun for folk in England, she was nearer to the sun than the earth for folk in America. But, unfortunately, falling into the mistake himself, he missed the joke, or rather he made it in his own person.

MARK TWAIN has seemed of late years to have conceived some degree of disgust at science—witness his "Fables for Good Boys, Old and Young." Possibly he thought that his rather laboured jokes at scientific methods and language, might cause men to forget the more splendid joke he had made unwittingly at his very first scientific attempt.

BE this as it may, he has succeeded recently in imagining a scientific blunder almost as funny as his self-made one. Students of science have occasionally extended numbers, good for a particular era, somewhat too boldly into far remote eras in the past and in the future. It has always happened in such cases that other students of science have pointed out the mistake and indicated the limits of time within which such calculations must be kept. Of course, there have been cases where the self-styled religious have made more noise over such points than students of science, as in the famous case where a preacher in America proved to his own satisfaction that Niagara had begun to cut the channel which it assuredly has cut, at about the time assigned by Bishop Usher to the Creation, and was rather staggered at being told that it was awfully wicked of him (by his own showing about others) to say so, for that left no time for the deposition of the rocks cut through, which tell of periods at the very least ten times as long. But usually, outside corrections have been rather petulant than amusing,—and science has had the work of sound correction, or the task of exhorting to caution, altogether to herself.

IT will be understood, then, how much point there is —let the fun in it be what it may—in the following remarks by Mark Twain :—

> In the space of 176 years the Lower Mississippi has shortened itself 242 miles. This is an average of a trifle over one and three-tenth miles per year. Therefore, any calm person, who is not blind or idiotic, can see that in the old oolitic Silurian period, just 1,000,000 years ago this month, the lower Mississippi was upward of 1,300,000 miles long, and stuck out over the Gulf of Mexico like a fishing-rod. And by the same token any person can see that 742 years from now the Lower Mississippi will only be a mile and three-quarters long, and Cairo and New Orleans will have joined their streets together, and be plodding comfortably along under a single mayor and board of aldermen. There is something fascinating about science. One gets such wholesale returns of conjecture out of such trifling investment of fact.

ALSO, dear humourist, one can so easily make glorious blunders, and get so absurdly and so unnecessarily annoyed over them.

THE Bishop of Hereford, when he was Dr. Jas. Atlay, Fellow and Tutor of St. John's College, Cambridge, and head of the side to which I belonged, used to tell the story, since widely published, of the child who being asked, What is an average? answered "Something on which hens lay eggs." The answer was found perplexing, till she explained that she had seen, a few days before, that hens lay so many eggs a year, *on an average*. If I remember rightly the answer was given to Dr. Atlay himself.

AND now I hear of a still odder answer, as having been really given at an examination—indeed, like the last, it is too good to have been invented. To the question, "Who was Columbus?" a little girl replied, "Columbus was a large bird." This answer being received, perhaps naturally, with somewhat vociferous laughter, she explained that she had read in an elder sister's book, a piece of poetry about the egg of Columbus, and she did not see how Columbus could have laid an egg unless Columbus was a bird. She thought Columbus must have been a large bird, or they would not have made so much talk about his egg.

THIS little girl was ill-informed respecting Columbus. But was she much more ignorant on this special subject, about which be it remarked she did not pretend to know anything, than a certain archdeacon was of law, when, uninvited, he suddenly amazed lawyers by saying that "Drinking is the only vice of which we can cut off the entail"? which as a well-known writer remarked would imply that Archdeacon F. wished us to obtain the fee simple or possess the whole drinking estate.

OR than the Welsh clergyman, who without any occasion to stagger his audience by astronomical profundities, told them that "So many stars make a planet; so many planets make a constellation; so many constellations make a Milky Way; and six (!) Milky Ways make an Aurora Borealis"?

I WONDER, by the way whether in the closing statement of this scientific Welshman, there may not be a sort of development of a story I am fond of telling in one of my lectures—viz., how, at a certain middle-class examination, in reply to the question, "What is the Milky Way?" there came the answer,—"The Milky Way is a kind of cloud in the sky, called the Trade Winds, or the Aurora Borealis."

Reviews.

SOME BOOKS ON OUR TABLE.

Suicide; its history, literature, jurisprudence, causation and prevention. By W. WYNN WESTCOTT, M.B., London. (London: H. K. Lewis. 1885.)—Alike by the sociologist, the moralist, the student of medical jurisprudence, and the psychologist, will Mr. Westcott's volume be found interesting. He has obviously brought to its composition wide reading and painstaking research, in addition to the practical knowledge of his subject derived from his official position as Deputy Coroner for Middlesex. In fact, he has supplied a distinct want in the English literature of suicide, inasmuch as he covers succinctly the whole field of the question of self-destruction; while the most recent work immediately preceding his (we refer to the translation of Professor Morselli's work in the "International Scientific Series") consists almost wholly of statistics, which, however valuable for special purposes, scarcely commend themselves to the great majority of readers. Ranging, as we have said, over the whole field of self-murder, our author treats on the ethics, history, jurisprudence, rate of increase, causation, and means of suicide; as also of its prevention, incidentally giving accounts of the most notable suicides, ancient and modern, the curious epidemics of this crime which have from time to time prevailed, &c. In the unhappy presence of the fact that a notable increase in the percentage of suicides appears to have taken place in this country within the last few years, the importance of Mr. Wynn Westcott's book will be recognised, and we can only hope that its circulation will be commensurate with its merits. In such case it cannot fail to be very extensive.

How to Get Strong, and How to Stay So. By WILLIAM BLAIKIE. With illustrations. (London: Sampson Low Marston, Searle, and Rivington. 1880.)—This is an English reprint of an American work, in which minute and detailed instructions are given for gymnastic exercises suited to all sorts and conditions of men, and, incidentally, of women and children too. In point of fact, we are not sure that the ladies will not be as much interested in Mr. Blaikie's excellent book as the men themselves; inasmuch as the explicit directions it contains for developing various individual muscles will enable the fair sex to attain the most perfect symmetry of form, in glorious independence of the various adventitious aids of whalebone and wadding. Among the other amusing chapters in the volume before us is one illustrating the importance of gymnastic training for our police and firemen. Readable as the book is, it derives some additional piquancy from its slight American peculiarities of diction. By what we can only regard as an odd coincidence, an appendix contains such tables as were asked for a week or two ago by a correspondent (Mr. J. H. Ward), to whom the Editor would seem to have replied on p. 14.

Lessons in the Art of Illuminating. By W. J. LOFTIE, B.A., F.S.A. (London: Blackie & Son.) — To the patient love which prompted the Irish ecclesiastics some 1,200 years ago to beautify and adorn their MSS. with elaborate ornamentation in colour, we are indebted for an art which culminated in this country during the earlier part of the thirteenth century, when the fame of the Scriptorium at St. Alban's was at its height. Certainly no one can inspect some of the marvellous specimens of artistic work in the shape of Bibles, Psalters, and Horæ in the National Collection at the British Museum, without being struck with a kind of dumb amazement at the industry, persistence, and perseverance which must have been exercised in their production. That so refined a form of art should have been revived in these days will cause no surprise in the mind of any one who will consider how the sense of the Beautiful has been, and is being, developed among us, and how it is made to minister to our gratification in every way, in our dwellings, surroundings, and common articles of use. To all who may wish themselves to reproduce anything akin to the glorious achievements of mediæval days, to help towards effective Church decoration, or even to adorn a photographic album, Mr. Loftie's book will be welcome. He gives minute general instructions for illumination, as an introduction to detailed descriptions of the working of every one of the very numerous illustrations which crowd his handsome volume. When we say that it forms one of Vere Foster's Water-Colour Series, we need not add that the coloured facsimiles of illuminated MSS. are admirably executed.

The Skilful Cook. By MRS. MARY HARRISON. (London: Sampson Low, Marston, Searle, & Rivington. 1884.)—Simple and perspicuous in her language, and at once plain and methodical in her detailed instructions for the preparation of every one of the very numerous dishes she describes, Mrs. Harrison has produced a book which every lady should present to her cook forthwith. Indeed, we may say *en passant*, that it will not be wholly without advantage if the gift be previously carefully studied by the donor herself. For the servant who will thoroughly master the contents of this small volume will truly be entitled to rank as "a skilful cook," and will assuredly find her market value very considerably enhanced by such mastery. In addition to the receipts proper, fourteen pages are devoted to menus, a part of the work which will be found very valuable by the young housekeeper. The very cover of the book, with its red leather back, is a sensible one, and suggests the idea that it is meant for *bonâ-fide* kitchen use.

Observations on the Preparation of Mineral and Rock Sections for the Microscope. By JOHN ERNEST ADY. Reprinted from the *Mineralogical Magazine*.—The study of petrology, or that of rocks in their mineralogical and minute structural rather than in their massive character is comparatively modern. It is mainly to Mr. H. C. Sorby that we are indebted for our knowledge of their microscopical characteristics. The slightest consideration will show, however, that it is impossible to investigate the minute structure of rock without reducing it to a thinness which shall enable it to transmit light, and to this end it must be sliced, subsequently ground and polished, and mounted in Canada balsam. In this pamphlet, Mr. Ady gives an illustrated description of the entire process. It will be found very useful to beginners intending to employ it.

Our Corner. May 1, 1884. (Freethought Publishing Company.)—This is sent to us as containing an exposition of "Hylo-Idealism," by "C. N." Any one interested in that hypothesis will find it developed here.

Cope's Tobacco Leaves. Part I. May, 1885. (Liverpool: Office of "Cope's Tobacco Plant.") This is made up of a very heterogeneous selection of essays, all, however, bearing more or less on what the elder Mr. Weller called "the flagrant veed." The frontispiece is a copy of Adrian Ostade's well-known "Smoker," and other illustrations are scattered through the text. Every smoker—and we may add non-smoker too—will find something here to amuse him.

Where to Find Ferns. By FRANCIS GEORGE HEATH. Illustrated. (London: Society for Promoting Christian Knowledge. 1885.)—Here is a little book to be carried in the pocket of the fern-hunter "whene'er he takes his walks abroad." It gives a general account of Ferns, their structure, fructification, and manner of growth, together with an explanation of the technical terms used in describing them. This is followed by a profusely illustrated chapter on "Fern Habitats," and by a shorter one on the cultivation of ferns. After this all the British species are described seriatim, each in a small chapter, in which every description is followed by a list of the places where the fern to which it refers is found. Chapter L., on "Ferns round London," may be studied with pleasure and profit by all holiday-makers, the low price at which the volume is issued placing it within the reach of almost everybody.

Ambulance Work. By R. LAWTON ROBERTS, M.D. (London: H. K. Lewis. 1885.)—The volume before us consists of a reprint of five lectures delivered by Dr. Roberts to ambulance classes held in connection with certain Welsh collieries and ironworks. The first one gives a *précis* of human anatomy and physiology; the second deals with hæmorrhage or bleeding, the third with fractures, the fourth with sudden attacks of illness, suffocation from various causes, &c., while the concluding one is devoted to describing how to lift and carry the wounded. Simple and apprehensible in diction, and well illustrated by thirty-eight capital woodcuts, this is a work which must commend itself to every one liable either to accident in his own person or to be called upon to render aid in the case of another.

Moffatt's Geographical Reader. Nos. I., II., III., and IV. (London: Moffatt & Paige.)—If we needed an illustration of the manner in which the teaching of geography has improved of late years, we should find it in the four volumes lying before us. As far as our recollection of our own maiden essays in this department of knowledge are concerned, we seem to remember it as rather a dreary subject than otherwise; but the compiler or compilers of this series has—or have—certainly succeeded in rendering it both amusing and attractive. The common sense of the method pursued in Volume I. of teaching a child what places in its own neighbourhood look like in a map must commend itself to every one.

History of the Statistical Society. By FREDERIC J. MOUAT, M.D. (London: Edward Stanford. 1885.)—In this pamphlet Dr. Mouat gives the history of the Statistical Society from its inception in 1834 down to the date of the celebration of its jubilee. Heretical outsiders, seeing how anti-vaccinators and the like manipulate statistics, are apt to believe that *anything* can be proved from them if skilfully cooked. Those who, in accordance with the sound old maxim, *audi alterem partem*, care to hear the case as ably put by the other side, should read Dr. Mouat's book.

The Child's Pictorial, (Society for Promoting Christian Knowledge)—is, with its gaily-coloured illustrations, as bright and taking as ever.

WE have also on our Table *Bradstreet's*, *The Sanitary News*, *Wheeling* (a marvel of "wheel" information, gossip, and fun at an almost nominal price), *The Medical Press and Circular*, *Electricité*, *The Mason College Magazine*, *The Tricyclist*, and from Messrs. Cassell & Co., *The Countries of the World*, *Cassell's Household Guide*, *The Book of Health*, *Our Own Country* (as delightful as ever), *The Library of English Literature*, *European Butterflies and Moths*, and *Cassell's Popular Gardening*, one and all sustaining their already well-earned reputation.

THE FACE OF THE SKY.

FROM JULY 17 TO JULY 31.

BY "F.R.A.S."

DAILY watch should be kept upon the Sun for spots and faculæ. Map VII. of "The Stars in their Seasons" exhibits the aspect of the night sky. Minima of Algol will occur at 1h. 10m. a.m. on July 26, and at 9h. 58m. p.m. on the 28th. On and after the 21st, twilight will cease to persist all night, and there will be a short—but, of course, gradually increasing—period of real darkness. Mercury and Venus, which are in conjunction at two o'clock this afternoon, may both now be picked up with the naked eye after sunset over the W.N.W. horizon. Mars is invisible, a remark which applies to Saturn, Uranus, and Neptune, and Jupiter is so very low down by the time it gets dark, as to be almost beyond the reach of the observer with the telescope. We append a list of the phenomena of his Satellites which may possibly, though, perhaps, not very probably, be observed. On the 20th, the shadow of Satellite III. will enter on Jupiter's disc at 8h. 57m., and the Satellite itself quit his opposite limb at 9h. 21m. On the 22nd, the transit of Satellite I. will begin at 8h. 55m., and Satellite II. pass off the planet's face at 9h. 4m. On the 23rd, Satellite I. will reappear from eclipse at 9h. 9m. 54s. On the 29th, the transit of Satellite II. will begin at 8h. 57m. On the 30th, Satellite I. will be occulted at 8h. 9m., and on the 31st, Satellite II. will reappear from eclipse at 7h. 49m. 44s., and the egress of the shadow of Satellite I. happen at 8h. 22m. The Moon enters her first quarter 19·8 minutes after midnight to-morrow night (the 18th) and will be full at 2h. 22·8m. a.m. on the 27th. Three occultations, all of stars of the 6th magnitude, will occur during the next fortnight. The first happens on July 18, when *m* Virginis will disappear at the Moon's dark limb at 10h. 10m. p.m., at an angle from her vertex of 184°; reappearing at her bright limb at 10h. 27m., at an angle of 215° from her vertex. Then on the 20th, o^2 Libræ will disappear at the dark limb at 10h. 58m., at a vertical angle of 136°, and reappear at the bright limb of the moon at 12h. 1m., at an angle from her vertex of 272°. Finally, on the 22nd, 29 Ophiuchi will disappear at her dark limb at 10h. 31m., at an angle of 33° from her vertex; reappearing at the bright limb at 11h. 1m., at a vertical angle of 356°. The Moon is in Virgo all day to-day and to-morrow, crossing the boundary into Libra at 5 p.m. on the 19th. There she continues until 6 p.m. on the 21st, when she enters the narrow northern strip of Scorpio. Ten hours later—*i.e*, at 4 a.m. on the 22nd—she has traversed this and entered Ophiuchus. Through this her path continues until 2 a.m. on the 24th, when she enters Sagittarius, out of which, at 4h. 30m. p.m. on the 26th, she passes into Capricornus. Her journey through Capricornus is completed by noon on the 27th, at which hour she enters Aquarius. She is travelling across Aquarius until 6 p.m. on the 30th, when she enters Pisces. There we leave her.

THE census of the population of Austria at the close of 1884 has just been published. The total was 22,864,106, of whom 11,170,468 were males, and 11,693,638 females.

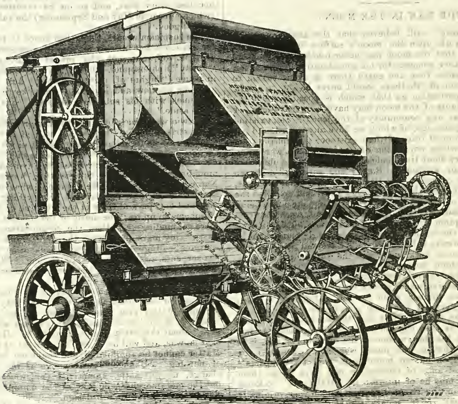
PHOTOGRAPHIC APPLIANCES AT THE INVENTIONS EXHIBITION.—We have frequently alluded in these columns to the increasing popularity of photography as a fashionable amusement amongst amateurs, and no stronger evidence of this could be adduced than the extensive and varied display of photographic materials and appliances to be seen in the South Central Gallery of the Inventions Exhibition. We have already explained that this popularity is owing in a great measure to the substitution of dry for wet plates, whereby the cumbrous paraphernalia requisite for photography under the old conditions was at once abjured in favour of light portable apparatus, and all the disagreeable associations of chemical sensitising by the operator were dispensed with; but a personal examination of the exhibits referred to is necessary in order to fully realise how much has been done by manufacturers of photographic appliances to render the pratice of the art a luxury rather than a bore. The stall of Messrs. Marion, of Soho-square, is noticeable for the extreme simplicity and effectiveness of many of their novelties, amongst which may be mentioned compact sets of everything necessary for taking pictures—practical working instruments, not toy articles—some of them, at the very moderate cost of thirty shillings; they also exhibit dry-plates known as the "Extra Rapid Britannia," which are extremely easy to work, and give good results in the hands of amateurs. These improvements have rendered photography a fashionable amusement amongst Englishmen at home, whilst its charms have already been acknowledged by our cousins in the United States, and will doubtless soon become equally popular in the Colonies.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine) than is accorded by the most excellent trade journals.*

STRAW-TRUSSING MACHINE.

[Patent 6,759. 1884.]—The accompanying illustration represents Howard's Straw-trussing Machine, fitted with Marshall's feeding arrangement, attached to a threshing-machine for work.



This straw-trusser will bind into sheaves, automatically, the whole of the straw as it leaves the shakers of a threshing-machine. It requires no attention beyond the removal of the sheaves as they are delivered from the binder; and except the cost of the twine, saves the labour of the several men necessary for binding the straw into sheaves by hand. The average cost of twine required to bind a ton of straw is a shilling, which is not more than the expense in labour of making straw bands to bind the same weight of straw.

The machine is easily understood and readily managed; it is very portable and compact, and being mounted on three travelling wheels, is rendered convenient for the application of shafts, horse or bullock pole for draught, or it may be coupled to the back end of a threshing-machine by a suitable draw-bar, and removed from place to place in this way, either by horses or a traction-engine. No fixing or securing to the thresher is necessary for work, the trusser being simply wheeled to the machine, and the driving-chain attached.

The straw on leaving the shakers of the thresher slides down the side of the hopper of the trusser, and is carried forward by the revolving rollers to the collectors, which receive and compress it against weighted levers; and when the required quantity of straw is collected to balance and move the weighted levers, the binding mechanism is thereby started, the pair of binding arms from below the collected straw rise up, enclose and bind it with two bands, while the truss is under compression. The sizes of the trusses may be regulated to suit different requirements.

RUDDER FITTINGS.

[Patent No. 10,575. 1884.]—This invention, by Mr. H. Emanuel, provides the means of instantaneously shipping or unshipping the rudder, by day or by night, while a boat is afloat or under way. It is manufactured throughout of non-oxidising metal, and the barrel is hard drawn. Those who have had any experience of sailing can understand the difficulty of shipping and unshipping a rudder in the water, and more particularly in the dark, attached by the ordinary method of pintles and eyes. Mr. Emanuel's plan is to fix a slotted barrel to the transom of the boat in lieu of the usual gudgeons; and as the rudder carries between its straps a continuous spindle, the latter only requires to be inserted in the bore of the barrel to at once fall into working position by the force of its own weight.

STAIR CLIPS.

[Patent No. 12,614. 1884.]—These new stair plates or nosings, patented by Mr. F. W. Hembry, Newgate-street, London, are a combination of metal-gauze and India-rubber, and are claimed to be superior to the old form in brass and iron. The metal-gauze is first placed upon a backing usually of a thin rubber cloth-like texture, which is coated thickly with rubber cement. Above this wire gauze or perforated metal plate is again spread a quantity of cement, which not only passes through all the holes of the mesh but also is the means, after vulcanization, of firmly securing the rubber on the surface. This being bent to its proper form, and vulcanized becomes one of the best protections against falling or slipping, and prevents the wear and noise on stairs.

THE PANAMA CANAL.—At the close of 1884 the Panama Canal Company had no less than 20,239 agents and workmen in its employment. The duration of each working day has been fixed at ten hours, viz., from 6 to 11 a.m. and from 1 to 6 a.m.

TO CORRESPONDENTS

"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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THE MAN IN THE MOON?

[1812]—"Hallyards" still believes that the absence of any traces of human work upon the moon's surface is sufficient to warrant the belief that the moon was never inhabited; I venture therefore a few further remarks for his consideration. The moon being so much smaller than the earth there is every reason to suppose that the chain of life there would never be able to attain a degree so near perfection as that which is possible upon the earth. The inhabitants of the moon may have been cave-men, or even as advanced as any community of the *genus Homo*, existing over five thousand years ago, of which we have any record, and yet have left not the faintest trace of their existence perceptible from the earth. If the whole population of Central Africa were annihilated to-day, a very short time indeed would suffice to obliterate all evidence of their existence. But if the superiority of the Lunarians is to be conceded, we may go to the other extreme, and suppose that before their extinction they had excelled the present civilisation of our globe; in which case, our ideas being limited to the civilisation of the past and present, we could form absolutely no conception of the works of a greater civilisation or of their ruins; just as the intelligence of a pre-historic man would be powerless to discriminate between Fingal's Cave and St. Peter's at Rome, which was human work and which the work of nature.

"Hallyards" "cannot conceive any reason why the Pyramids should not last as long as the earth itself." The primary reason appears to be because civilisation shows no disposition to tolerate the existence of such lumber, even for the antiquarian's sake; already the Great Pyramid has been considerably despoiled to build a portion of the City of Cairo, and the work of destruction will be accelerated as that city increases in importance; so far, man is an agent in the destruction of his own work, and it is readily conceivable that if the moon was ever disfigured by "ramparts" (hard upon human morality to expect "ramparts" to outlast it), the advance of civilisation may have swept them from its surface. It may be of interest to "Hallyards" to know that the dimensions of the Great Pyramid, which were originally 480 ft. in height, and 756 ft. square for the base, have been diminished to 460 ft. for the height, and the base to 732 ft. square; truly nothing wonderful for the work of four thousand years, if we compare it with other human erections, but still sufficient to rob it of its fame for stability; and although in its position it is favoured with atmosphere and weather less destructive in their effects than are common to most countries, its stone, two specimens of which I have before me as I write, show decided traces of natural decay. The Pyramids may be "as durable as any hill," as "Hallyards" says, but the hills themselves are susceptible enough to changes; for instance, those at Tunbridge Wells, which he considers to have been "abraded chiefly by storms."

"In an airless, waterless world like the moon what could destroy our great human works?" Nothing, perhaps, but the presence of such works in the first case, would indicate that there had been both air and water in times past, and the process of demolition may have been completed ages before the water was absorbed or the air had disappeared. (Query—since the oxygen of the air is being continually consumed by both organic and inorganic matter, does not this, to some extent, explain the rarity or absence of an atmosphere on the moon?)

I have seen a description of the so-called lunar canal, and also a criticism throwing discredit upon its human origin, but in what work or journal I cannot recollect.

Having little time to spare at present, I will take up the other points in his answer to my letter by and by. ALEX. MACKIE.

[Oxygen is not "consumed" in the sense used by Mr. Mackie. Oxygen goes into the lungs of animals, combines with the carbon contained in the different parts of the body, and is exhaled in the form of carbonic dioxide (the "carbonic acid" of the old books on chemistry). Plants breathe this, fix the carbon in their own tissues, and restore the pure oxygen to the atmosphere again by exhalation. —ED.]

NATURAL SELECTION.

[1813]—I will try and make clear to "Hallyards" (with whose gratification *I* am gratified) my meaning by "the excess being cut off."

Huxley remarks, *in re* the crayfish, that, on the whole, their numbers keep about the same in any given locality. Now this is just what seems to be the normal rule and *status quo* everywhere. Here, *e.g.* (Isola di Capri), from year to year, we note much about the same apparent amount of life—*e.g.*, a good many butterflies, but not so very many; a good many lizards, but not so very many; a few snakes (black and ground-coloured), apparently neither more nor less every year, and so on, *ad infinitum*. Even with quails (which appear in May and September) the rule, on the whole, seems to hold good.

The suspicion occurs, then, that there is, in reality, *no* struggle for *existence*, but merely for excessive existence. The superfluity are cut off, but not the proper quantity. My lovely (not "lonely") philosopher, whom I formerly subpœnaed and produced in court ("flights of painted moths," &c.) again says: "Little and big, minnow and leviathan, are alike to the Soul—that" (he continues, with his sublime audacity) "equally shoves Judas and Jesus aside."

Darwin was struck by the formation or metamorphosis of species. What strikes me is, *How the lid is kept down*. From the oldest laid-bare rocks forms meet us and greet us which meet us and greet us now: not only the uninteresting slug-shell, but the faërie dragon-fly, with the inimitable tracery of the Divine Architect (not carving, moulding, from without; but creating, becoming, from within:—Nature). How the lid is kept down is what strikes me:—Thus far shalt thou go, and no farther! Everything in its place:—every note and dot, jot and tittle of the gigantic orchestra, from the hum of ephemeræ up to "the music of the spheres." What, too, can be more astounding—*e.g.*, than the co-appearance of "the still small voice," tiny marsupials with the unutterable Saurians and Pterosaurians!—dragons ("that tare each other in the slime") and sea-serpents, swamp-serpents, 100 ft. long!! Will the selectionarians derive the Saurians from the marsupials: or *vice versa*, or how? Let us grope our way out of the fog!

Mr. Fountain (why should any of us quarrel? we are all only battling for the truth in the dark) was very severe upon me for saying "Matter ever was and ever will be." I am glad to see that "F. W. H." is an equally guilty sinner with me in "cocksureness" about this extra-Euclidean problem. He says, "Since whatever is, was, and will be." Self-evidently! at least since Lavoisier. Matter cannot be annihilated, and could not have been created out of nothing. "Change," yes, change is *the* law; but not *mere* change, unsystematic, unmotived (*unleitmotived*) change. No! but the metamorphosis of law, of the omnipresence, self-justified, self-existent, self-wise, self-design.

Yes; embryology does demonstrate that life begins with simple protoplasm. That reflection has not escaped me; but I turn it about to fight in my ranks. It begins with protoplasm, but not with *one*, one and the same protoplasm. Simple, but immense distinction! Each individual protoplasm (speck of jelly I sometimes call it) hath its own potentialities, marvellous, magical! (Truth is stranger than fiction!) And, for aught I know, the beginning, as we call it, may have been from countless millions of protoplasms with infinitely diverse potentialities. This theory is on the carpet.

"A Welshman" concedes what I want—namely, that the worm did not "acquire" (that is the Selectionarian Shibboleth) its softness, &c. I do not believe it "acquired" even its length. This is a matter of growth. Mr. Proctor has well reminded us that there are worms at the Cape a yard and more in length, and here, by the way, we see that these monsters have not extinguished the little tiny worms—rootlets, as Jean Paul calls them, of the universe tree, up to its fruit of stars.

"A Welshman" bases himself upon what the French term the *monde ambiant*, organism *cum* surroundings. This, of course, I admit (look, *e.g.*, at the transplanted plant, which from hairless becomes hairy. Look at the Americans, moulded by the *ambiant*

to likeness to the Aborigines.) This, of course, *I* admit, I realise; but this, just this, is what Mr. Darwin controverted as *the* cause—*the* cause, he maintained (with a lucid temperance of genius, of labour and learning, which I should be the last not to extol *in excelsis*), *the* cause, he maintained, lay in natural selection: *id est*, the selection by circumstance of what *happened* to show themselves *per* variation the fittest in the struggle for existence.

This doctrine of Natural Selection, as the Cause of Evolution, is what I am disputing; it seems rather to me a Consequence—of Nature's Invention: thus, Nature invented the recurved hooks of seeds, &c., and these were selected by, or even did select, Opportunity (see Shakespeare's marvellous musical eloquence about Opportunity in "Lucrece").

Again, the very basis of the Darwinian superstructure is Heredity. But *who invented Heredity?* Was that, too, "acquired?" I trow not!

And he says (basis again) the offspring tends to "vary" in the same part as the parent; but if the parent, *e.g.*, has a large foot, the tendency of the offspring to have a still larger foot can scarcely be termed variation; if it varied it might vary *away* from the parent. Moreover all such "variation" has its limits. Peas, to cite the case mentioned by Dr. Ball, do not go on getting larger *ad infinitum*. We do not see giants twenty feet high, whales 1,000 feet long.

Darwin is the Luther of the nineteenth century. That is why we so greeted him. He has struck open *our* Bible. What men are hungering and thirsting after is Religion—not Dogma, but Truth; not Superstition, but Nature; not Priestcraft, but God; the proof of immortality, which is alone interesting—*our* God—we are slowly coming to perceive, is what is plus the soul of what is, or, in my favourite phraseology from the poet whom we have as much right to call divine as the Italians have to call Dante, "the cause, the cause, my soul!"

Now, after all, "Natural Selection," though exquisitely ingenious, and true to a certain extent, seems to me, for one, rather a shallow explanation of the Problem of the Universe (*e.g.*, I do not believe the giants in those days were extinguished by Natural Selection), and Evolution itself waits for much further illumination and development.

I should like to make, as it were, a *pronunciamiento* of the statement—for the reflection of "A Welshman" and others whom this superb subject may concern—that Mr. Darwin stakes his reputation on the doctrine of Natural Selection, and, forsooth, in this utmost form, namely, that the most subtle and gracious organs and contrivances, "insect's wing and eagle's eye,"* Mozart's ear and Shakespeare's brain are the result of Natural Selection—that is, of tiny beneficial, or victor variations, transmitted and cumulated in the course of incomputable ages.

Now I, for one, do not believe that the eye, *e.g.*, was so "acquired"; the exquisite nerves for appreciating "The dew-dropping south o'er a bank of violets"; all, all this fabric of nervous tissue, myriad inlets for the infinite.

Nor do I exactly credit that the many and great gaps in the living chain are due to extinction *per* Natural Selection (another Darwinian *leitmotiv*). For instance, how plausible would it be for a mere outsider, theoretical Adam, beholding the beasts defile before him, to argue, *ecco* the lion! surely monarch of all he surveys; *he* must exterminate all! But no. The lion, lord as he is, is not numerous, whereas his timid victims—gazelles and other creatures are—make up for their feebleness by fertility, and, also, their modes of escape. Behold the horse! he, too, a magnificent animal! his neck clothed with thunder; running a race with the wind! but, luckily, he does not eat flesh; he is an innocent herb-eater. The whale is Leviathan; but lo, he actually exists upon Infusoria! What a lesson! what a moral! and so on throughout. *The* principle Darwin leaves out of sight almost, namely, compensation, advantage *and* drawback.

ALEX. TEETGEN ("Commentator.")

* "The eye, that most pure spirit of sense."—Shakespeare.

EVOLUTION.

[1814]—"Commentator's" attack on Darwin's theory because it does not explain *how* variation happens seems to me about as reasonable as if he were to find fault with Newton because the latter did not attempt to show the means by which gravitation acts. Newton proved that a law which we call gravitation exists, but how that force operates he could not explain. Shall we therefore depreciate the value of Newton's labours? Surely not; and why should "Commentator" seek to minimise the value of Darwin's work? Darwin set himself to prove (1) that organisms vary; (2) that there is no reason to suppose that there is any limit to this variability; (3) that, variability being granted, it follows that some forma *must* be better adapted to their circumstances than others, and will therefore survive. This is really all that is involved in Darwin's great theory. He sought, not to show how an animal can produce young which are *not* identical in all respects with itself: he merely took the fact of variation as he found it, and showed that all the rest follows from it.

It is difficult to make out whether "Commentator" disbelieves *toto cœlo* in variation, or believes that any given species can vary only within certain limits. If the former, he must surely disbelieve the evidence of his own senses. Can he find two human faces, for instance, that are precisely alike? If he believes in restricted variability, on what evidence does he base his belief? The fan-tail pigeon is the result of the selection of variations which took place in the common pigeon. But the fantail itself varies, some individuals being more divergent from the original stock than others. Is there any reason to suppose that the limit of variability has been reached?

But perhaps "Commentator" does not intend to dispute variability at all; but merely its spontaneity. If so, why does he quarrel with Darwin, who expressly refrained from theorising on a point as to which neither he nor anyone else could be possessed of any evidence? Whether variability is spontaneous (unscientific word!), the result of laws of which we have no conception, or the work of a Great Designer, makes no difference to the theory of evolution, for that theory only *begins* with the million-times-proved fact of variability. As well complain of the theory of light, because it does not explain the origin of the sun, as tilt against evolution because it doesn't make clear how the offspring of five-fingered parents sometimes have six digits on each hand.

CHAS. E. BELL.

VARIATION IN THE APPARENT MAGNITUDE OF SPECTRAL IMAGES.

[1815]—I have myself noticed the phenomenon of variation in the *apparent* magnitude of the *ocular spectra*, as the eye adapts itself to vision at longer or shorter distances, a phenomenon referred to in No. 192 (p. 12). I believe I have noticed the fact in some of my papers on "Light." I say variation in *apparent* magnitude, because there does not appear to be the slightest suggestion of a reason for a change in the *actual* magnitude of these spectra on the retina. The phenomenon was very noticeable after gazing at the coloured figures in that book, which was published some years since, for the purpose of illustrating the phenomena of the *ocular spectra*. The reasons for this *apparent* increase and decrease in the *spectra*, when the eye is adjusted for vision at shorter and longer distances, is this, that the spectral image persists on the retina of one constant magnitude, but this image being brought into juxtaposition with the diminished objects of a more distant field of vision appears *relatively* larger, and with the environment of the larger objects of a closer field of vision *relatively* smaller. Thus it is that the rule of perspective appears to be reversed. The important fact that the *ocular spectra* have no external existence whatever, does not as yet appear to be fully recognised.

W. CAVE THOMAS.

KING'S COLLEGE SCHOOL.

[1816]—Vol. VIII. of *K.* opens with a severe—all the more severe because not violent—attack on the masters of the above, from the pen of our excellent Conductor.

I claim to be heard as an expert in a double way. The Head-master and myself had a week-and-week rivalry, when we were fifteen, for the prize of the third form in our school. Stokoe was neither a bully nor a sneak, but an all-round good fellow, steady as he was genial. Our master died Head-master of Charterhouse; so he had a good model of what a master ought to be. I beat him in class-work, but he was superior in exercises, so had the prize. But we never had the least jealousy or meanness over our strife.

I hold Mr. Proctor absolutely wrong in his general canon that bad tone among boys lies at the masters' door. I know that schools change like society, and always—almost—from within. Those who make the tone of a school are the *leading boys*—and, as these are constantly changing, no *one can ever know* what a school is, save from the boys themselves. *E.g.* the very school I was at with Stokoe. The head-master had come into office nearly ten years before. I found myself laughed at for piety, persecuted for industry. By the time I had been there three years, all was changed! Piety rather the fashion, industry quite a *sine quâ non*. An idle fellow was rather a cad. What was the cause? If it was in the masters, it could have been only through the advent (in my first half) of a big, sneering, affected under-master, who was said to have driven an Oxford coach for *money*. He, first of masters, joined in the games. I think it not impossible this may have done *something*.

But I know another school—all interns—of gentlemanly nice fellows, whose masters were ignorant, ill-bred muffs. One of the senior students told me that the moral state of the place was *excellent*; whereas, when he came, a youngster of eight, it was a sink of iniquity. Now, the change here was *certainly* not wrought by the masters. Morals are like epidemics. I have no doubt that in the cases cited by Mr. Proctor the change *did* emanate from the masters. But that must have been by accident. It is as in society. The standard of morals is always fixed by the laity—whatever they determine on doing, the clergy must sanction eventually, or else they would have no adherents. Of course, they ought to submit to that disaster; but then they don't.

I felt pained at the admission of Dr. Stokoe that he did not know of the bullying in question; but I feel sure there must have been some special cause for his ignorance. It seems a pity, anyhow, to increase, at this moment, the very deep concern he must feel.

HALLYARDS.

"THE COMITY OF NATIONS."

[1817]—I always understood this to mean "that mutual urbanity which nations find it convenient to show toward each other" (from *cōmis*, polite). But in April, 1871, a great lawyer made a great speech, in which he spoke several times of the "comity of nations" as synonymous with "*community* of nations." I turned up Johnson and others, but could find no trace of the word *comity* other than as above. The *Times* based a leader on the speech, and repeated several times the same phrase in the same sense, with capital letters. I wrote to the *Times* expostulating, but was not inserted.

Now, in the *Saturday Review* for May 30, p. 718, I find "Japan's policy aims at the adoption of the fruits of Western civilization, and the attainment of a status of recognised equality in the comity of nations." Here is the self-same error.

There might, of course, be a word *cŏmity*=company, from *cŏmitatus*, whence comes our word *county*; but it would be most inconvenient to have two words of identical spelling, but diverse derivation and meaning; for then we might praise a judge and a riding-master, each for his *equity*—the one for *æquitas*, the other *equitatus*.

HALLYARDS.

"PRINTERS' DEVILRY."

[1818]—That "Hallyards" is a most exceedingly learned man, I have no earthly doubt; but (letter 1811) he does not seem to be quite so well acquainted with the writings of "the Divine William" as he might be, or else he would have known that the *Saturday* was quoting from Mrs. Quickly, "Henry V.," act ii., scene 3:—"Nay, sure, he's not in hell; he's in Arthur's bosom, if ever man went to Arthur's bosom."

G. SMALLPEICE.

GEORGE ELIOT.

[1819]—There is still a necessity, I think, for another word to be spoken in connection with George Eliot and her partner. The relationship has been too severely censured by "Commentator" and too much defended by Mr. Proctor. While sympathising with a great many observations ably expressed by the latter, I cannot help thinking that he has allowed his love and reverence for the writer to plead on behalf of what has always been considered reprehensible in Sand and Chopin. It is surely a healthy sentiment which demands from our teachers a higher morality than exists in the multitude. If there is virtue in our laws, surely it is right for one who could create for us an Adam Bede to make a sacrifice on their behalf. It is all very well to say that if Eliot and Lewes wronged no one personally, it was justifiable. In the first place, a wrong might occur to children. In the second place, the question, I think, is a far deeper one. Do such acts discredit the law, and is such an example a salutary one for society? While, no doubt, many things can be urged in defence of the happy fellowship of these celebrated people, surely a more heroic line would have been more in harmony with their teaching.

GAMMA.

A LONG SPELL.

[1820]—In your "Gossip" in KNOWLEDGE you say, "It is a misfortune that few men of science will condescend to avoid the use of technical terms." This is the more to be regretted when technical terms assume the form of those in the following paragraph, which I extract from *Science Gossip* for July, p 162: "It appears that some supposed pentanitrodimethylaniline has been shown to be trinitromethylnitroniline. The substance in question has been obtained from napthyldimethamidophenylsulphone."

G. H.

DIVERS REJOINDERS.

[1821]—*Condor* 40 ft. from tip to tip of wings.* I saw this about forty years ago, noted on the fly-leaf of a book, by my father, from (I think) Humboldt. It struck me so much that I have never forgotten it. I could wish it verified. It is not likely my father was wrong, as he had succeeded, before he was twenty-four, in having his name given to two places on the earth's surface; which, as "'ανδρῶν 'επιφανῶν πᾶσα μῆ τάφος," is certainly the neatest way of appearing on the tombstone. (Could I live in libraries, I would make a dictionary of all men in like case, with brief notice. This would be a geographical peerage, and useful companion to every geography.)

Satellites. Jupiter and Saturn certainly have some larger than the moon in *apparent* diameter; but, as J. and S. are held to be not yet condensed, and to be *going to be* very much smaller than they are at present, is it not reasonable to suppose that their satellites are in a similar puffy state?† Now, the one thing certain about the moon is that she is solid, and final, at all events.

Infinite divisibility. I am unable to see why one should be able to halve everything, without getting to a point indivisible. If we could, then I might say that because I have a pound in my pocket, I shall always have *some* money, because, however small the balance, I can always halve it. (This is flippant, of course.)

HALLYARDS.

BENEDICITE!

[1822]—I am deeply pained to find from Mr. Proctor's note on p. 11 that I have (it seems) wasted valuable space on nonsense. The only exit seems to be "the Hundreds." "I guess I shall jine a church this fall," as Artemus Ward says (or, stay—perhaps it was some other A. W.—Archbishop Whatily, for instance.)

I was perfectly certain the two statements in question had been made by Mr. Proctor; I cannot tell where, nor does it matter, since (at any rate) they do not represent his opinion. But this defect of apprehension convinces me that it is not only my sight that is failing me, and that I am not much in the right place in discussing science.

I remember Mr. Proctor writing of me years ago "by no means a fool, but fitter to be taught than teach." I never tried to do that. I have ventured to put certain sceptical ideas on paper, supposing that the acting Editor would not print absolute bosh.

The fact that a scientific opinion is universally received in no way proves its truth. Mr. Proctor himself (am I mistaken here?) showed that all astronomers had been childishly wrong about resolvable nebulæ being galaxies; and that Sir G. Airy was also in error as to a transit of Venus. He also wrote a paper called "A Menacing Comet," which frightened numbers of people. He has since explained that no comet, in his opinion, is likely to do any harm. If that be so, what did it "menace"? In spite of my almost extravagant admiration for him, I could not help feeling that the *SaturdayReview* was on the side of reason about "the *Spectator's* comet."

As regards the reply to me on p. 14, I should be really obliged if the following emasculated (but is *that* admissible?) statement be allowed to appear. The Editor severely snubbed a correspondent who wrote about what the Editor calls "a savage rite," and said it did no good. I wrote, showing, not only that it was invented by the beginners of all civilisation, but that it is alleged to produce the most serious moral and physical benefit. My language was carefully chosen—*virginibus puerisque*—though it is absurd to regard any such restrictions in a scientific discussion—it is like fighting with one arm tied—and the Editor burkes my letter. Probably he does right; but it does seem to me hard on the correspondent who was originally snubbed, and to whom our good Editor now devotes sixteen lines of disquisition on the merits of the rite in question, which he allows no one to *defend*.‡

I am extremely obliged to Mr. Butler for his courteous note and sketch of a buff spider, but it is not the same species as mine, which I examined with a lens. The legs are longer, there are five

* "This day I shot a Condor. It measured from tip to tip of the wings eight and a half feet, and from beak to tail four feet."—*Darwin's Jounal of Researches*, p. 182.—ED.

† Certainly not.—ED.

‡ Peccavi. I was wrong originally in permitting the initiation of a discussion which (however suitable to the columns of the *Medical Press and Circular*) was wholly out of place here. Had I, in common parlance, "had my wits about me," I must have foreseen how practically certain such a question must be to drift into all sorts of collateral issues more or less unsavoury, and unsuitable to the ordinary student of science. I am bound to say that nothing advanced either by Mr. Collins or "Hallyards" himself has caused me, in the slightest degree, to modify my opinion.—ED.]

depressions instead of three, and the corners are much sharper. I have since (in the very same place) seen one that was buff with green markings, recalling a jockey.

In 1882 I addressed to K—— a long letter, showing that the chronology of Miss A. B. Edwards, in her "Pithom and Ramses" articles was totally impossible. This was not inserted, but sent to Miss E., who addressed to me in next no. a very courteous note. I then resolved to confine myself to enriching K. with auroras, zodiacal lights, and other meteors, which are to scientific what the humble "enormous gooseberry" is to general journalism; and I renew this resolution now. Should I ever be tempted to write mere opinions, or quotations, or arguments, I really think the kindest course for the editor to follow will be simply W.P.B. and silence—but a note *based upon* a burked letter is very apt to prejudice the correspondent. *Vaya con dios!* HALLYARDS.

P.S. At first I did not intend to comment on Mr. Proctor's notes; but it has occurred to me that it was inferred from the probable rectilinear motion of the *majority* of stars that there would be collisions; that these, though apparently accidents, might in reality be foreseen, and part of the provision of the cosmos. I incline to believe that this was in the papers on Sir W. Herschel's views as to the distribution of the stars, this year (to which I am unable to refer at present). If it was not there, it was certainly not an "outer barbarian" who wrote it, but one of the "inner circle"—of "the clever ones" (Mrs. Clennam & Co.)—of those who justly say "we are they that ought to speak—who is lord over us?"

If the above (about collisions) is pure imagination, how is it that I am aware that the following is indeed so?

A century ago Sir W. H. discerned that the sun is moving, very much slower than the earth in her orbit, towards a point in Hercules. There is, hitherto, no change in *direction* observed (though the no. of miles per second is declared?). Therefore, if the sun is moving in a curve, it is so vast that in a century it does not appreciably differ from a straight line. This does not show it to be one; but, so far, it may be supposed to be straight. Mr. Proctor (?) has shown that Mädler was quite mistaken in his "central sun" theory.

When I wrote "It will be replied," I had not the least idea of Mr. P.—so there is no creation of a "semi-idiotic second self."

"It will be replied that their rate of translation will overcome the pull of the nearest body—though any one who would reply thus would say anything." ("I think my friend Mr. —— of the —— club said he knew you."—"*There's fellers in that club would say anything,*"—replied the—(certainly not amiable)—character. I here cite from Thackeray.)

I am disconsolate to be found wrong about so simple a matter. I thought that in the case of one body revolving round another there are but two forces in question. The smaller may be conceived passing in a straight line; the pull of the larger is just sufficient to convert this motion into a curve; erroneously described formerly as centrifugal and centripetal force. That is what I meant. Put so much more "rate of translation" on the earth, and it would overcome the sun's pull, and she would go off in space in a straight line—saving accidents. The suspected companion of Venus is supposed to have got loose in some such way.

A correspondent pointed out the other day that Mr. P. had stated that space must be infinite. I refrained from saying that that in no way convinces me he has not said also the contrary. (Because it is a mere matter of speculation; a wise man's opinions are liable to change; and when a man writes a great deal he cannot possibly remember all he writes. "Commentator" complained lately that Mr. P. had contradicted himself flatly about the present habitability of the planets; I believe he did.) He tells me he *has* said "we cannot *conceive* infinite space,—a mightily different matter." Different, *concedo; mightily* so, *nego:* contrariwise, it is a long step towards my version. It is *still more inconceivable* that space should be finite. I believe the human mind will never be able to comprehend the real state of the question at all. It was created for its own special needs, and no higher. I can imagine a mind as far above it as Mr. P.'s is above my own. H.

A DREAM.

[1823]—I subjoin an extract from a letter, received on Monday last, from a son of mine who is in command of the fastest s.s. in the New Zealand waters, merely premising that the "poor N——" referred to was a younger brother of his who was washed overboard in mid-Atlantic, and the "poor P——" a quadroon, who returned with me from the West Indies in the eventful year 1848, and who nursed him and all his brothers and sisters, except the eldest, but died last January twelvemonth:—"Now, my dear father, I am going to tell you an astounding fact. On the date poor N—— was drowned I saw him struggling in the water on the port-side of a steamer in a stormy sea, when all at once he disappeared, and directly after, in my dream, I saw poor P—— sitting at the foot of my bed. She said, "Not you," and vanished. I woke up, went on deck, and told the chief-officer of it, and, on my return below, I made a note of it in an almanack. Since then I have worked it out, and it tallies to the *moment* of the sad occurrence" (I having given him, in a letter to which the above was his answer, the latitude and longitude, with local time of it). W. A.

MENTAL PHENOMENA.

[1824]—I was much struck the other day by a little French boy informing me that his grandfather's peacock was sometimes heard as far as Noirmentier (an island ten miles off). This, examined, turned out to be based on a reported fact that some one had heard it *on the sea—i.e.*, a few hundred yards away. But, on reflexion, I could not deny that the original statement was specious. Thus:—

The peacock is heard on the sea,—
Noirmentier is on the sea,—
Therefore the peacock is heard at Noirmentier.

Just after, I took up a printed letter of the Card. Abp. of Paris to the Pope. In the first two lines H. E. tells H. H. that he had recovered from a dangerous illness, "thanks, I think, to your H.'s blessing."

Now, was the Abp. more logical than the child? Does he hold that none ever recover without the Pope's blessing? If he does not, how does he connect cause and effect?

It is like Tenterden Steeple and the Goodwin Sands; and not altogether unlike some modern speculations on cause of man's survival.

I believe there will always be Christians: but it is surely time for churchmen to "report progress" on some points, and "tacitly recede from" (Card. Newman's phrase) prayers for fine weather, and against earthquakes, thunderstorms, and pestilences.

There is a collect (8th after Trinity)—which I never could read gravely. Who are "we," that we should get all profitable things (the orig. has "cuncta" and "omnia") and escape all hurtful things (of course to the detriment of some of our "dearly beloved brethren" elsewhere.) HALLYARDS.

MEAN-TIME SUN-DIALS.

[1825]—I propose having a mean-time sun-dial constructed, and shall be much obliged to "E. L. G." (with reference to his letter, No. 1724, page 465) if he will tell me how he derives his rule for the ordinates. It had seemed to me that if the radius of the hour circle were multiplied by the sine of half the equation of time, plus the quantity S (expressed as angle), we should have the true length of the ordinate, the axis of the gnomon passing through the centre of the circle; but I have no doubt that he is right.

In the expression for the abscissa, the factor $(1 - \sin^2 \overline{N+S})$ might, I think, be omitted, as (except in the case of very large dials) its effect on the length would be inappreciable.

Since writing the above I have seen E. L. G.'s letter, No. 1658, p. 290 (previously overlooked), which gives the explanation asked for. The factor $(1 - \sin^2 \overline{N+S})$ may certainly be omitted. In small dials it would make no difference, and in large ones the edge of the shadow is so vague that great accuracy is impossible.

MUSAFIR.

LETTERS RECEIVED AND SHORT ANSWERS.

JOS. HORNER. The reply which you enclose was written by the Conductor of KNOWLEDGE, and I had never even seen it before. Nor, so far as I am aware, was your MS. in existence when I took over the editorship about the end of last June. Hence the seeming inconsistency, which I can only sincerely regret.—AN ANONYMOUS CORRESPONDENT forwards a leaf cut from *The Bazaar* of July 3, containing grave charges against the promoters of the *Golden Argosy* scheme of prizes, and complaining that these prizes were advertised in KNOWLEDGE. I must reiterate that the appearance of an advertisement of any sort in the columns here devoted to them can and must in no sense whatever be held to imply any sort of editorial guarantee for its *bona fides.* Of course, an announcement *known* to emanate from a doubtful source would be refused insertion, but advertising belongs to the business department of the paper, with which the editor has nothing whatever to do.—J. WEBB asks Mr. Clodd for the name of the publisher of the reissue of the "Biblia Pauperum"? With regard to your request for a Greek Lexicon, I myself always use the English edition of Schrevelius, in which the definitions are, as you require, framed on philological and not on merely doctrinal grounds.—W. invites "Coleford's" attention to the circumstance that, according to his

("Coleford's") theory, if Mr. and Mrs. Jones have four children, there must be four fathers and four mothers altogether!—E. G. S. I do not know of any dictionary devoted expressly to the explanation of scientific terms. A considerable proportion of them will be found in such books as Ogilvie's "Imperial Dictionary." I must add, though, that it is a rule that all contributors to KNOWLEDGE should explain every technical term they employ when it first occurs; and hence that readers of original articles in these columns should never need to refer to any extraneous source at all for the meaning of words which occur here.—J. W. ALEXANDER. I am sorry that I am unable to print your letter, but the "Mind and Matter" discussion has now dragged out to such a weary length, and has been so wholly barren of any fruitful result, that I am compelled to close it.—C. HILL. I do not insert your circular because I am firmly convinced that the opening of museums, &c., on Sunday would be a very great national boon. As for your idea that it would lead to Sunday labour, the Trade Unions will take exceedingly good care that it does not do that.—AN ANONYMOUS CORRESPONDENT sends me a *Birmingham Daily Mail*, containing an account (from the *Sheffield Star*) of the finding of a live toad in a block of coal! The "silly season" seems to have set in very early and with unusual severity in Sheffield this year.—WILLIAM MATTHEWS. So far I have only received your letter, the "accompanying communication" not having reached me.—COMMENTATOR. I do not reproduce M. Ramus's article because it is utterly unsound. The axis of the earth can never have been perpendicular to the plane of the ecliptic for dynamical reasons. Its variation is secular, and the extreme possible limits of it are 2° 37′ 22″. What does the fly-leaf on "Titles" mean? Thanks again for photograph.—ARNOLD REED. You can scarcely hope to pass well in honours in electricity without some knowledge of mathematics, that is if the examination is what it ought to be. Prof. Thompson's "Elementary Lessons in Electricity and Magnetism" will give you a good insight into the subject. It is, of its kind, the best in the market.

Our Paradox Column.

[I print the subjoined letter from our old friend the author of the "P. D. Theory" as a specimen of close and sustained reasoning on a scientific subject! Perhaps some reader can explain what on earth it is all about. No one to be allowed more than three guesses.—ED.]

July 2nd 1885 Newcastle

EDITOR DEAR SIR If the "Tit Bits" in KNOWLEDGE June 19th, 26th; came from Hallyards, Commentator, Gamma, A Welshman, F. W. H. and others,—If they would read their Book of Time, which is composed by the matter of thought and printed only on The mind of man,—They would surely have one and the same idea about "Darwinism or Protoplasm or the immanence of Life in matter," Mr R. A. Proctor says, men were once deceived with regard to time. They thought the duration of this earth represented all time—was, at least, central in time; But, they know it now as infinite time; What says the Book,—I am, no other substitute is capable of holding the same power's as I am the main-spring of life, and the duration of all existence. It seems to me bosh, to fancy that duration can be parted from existence, how can any-thing exist without time or how can time proceed without the motion of something existing. As there is no substitute for time, as it is composed of intervals of infinite variety, as it will have its own way so must things be so;—Time keeps the matter in motion continually by its exigence and granulating process, which forms the river's of life going out of one element into another, each element been refreshed and restored by receiving supplies of energies passed down from one element to another. This change of matter proceeds from the granulating process, were the heavy particle's displace the lighter particle's, causing the formation of gravity to set in, as a momentum action between the centre point and the external points. Mr Proctor says, The actual process of restoration, which, to us, seems so simple a matter, could not possibly suggest itself to creatures having their limited knowledge and experience. That the air in which they lived contained the stores from which the river's, so unlike in all respects, was constantly nourished,—It could not occur to their minds at all:—If (tit bits) cannot follow "Darwin" through his little stream of life. How-ever will they be able to follow through the great sea's of time. time with its infinite season's will bring our earth to what it was once before, and what it was ten thousand times before that, it must return with its season, no change. Infinite time produces infinite season's, years don't count.—Yours, truly,

J. MURRAY.

Our Whist Column.

BY "FIVE OF CLUBS."

DECLINE AND FALL OF WHIST.

UNDER this title, Pembridge, author of the lively treatise, "Whist or Bumblepuppy," has published a jeremiad—an old-fashioned view, as he calls it, of new-fangled play. He rejects the developments of modern whist as tending to the injury and eventually to the destruction of the fine old game. There is so much truth in what he says, though it is not all truth, that I take pleasure in helping to make as widely known as possible his protest against the mischievous tendencies of some of the modern teachings.

OBJECTIONS TO "THE PETER."

Pembridge first attacks the signal for trumps. And truly when one considers how the signal is too often used, one cannot wonder (I beg and entreat the compositors not here to substitute the offensive "he" for my "one")—one cannot wonder, I say, if a strong player should be disposed to rail against the abuse of a signal which, properly used, is very valuable. The signal ought to be an imperative call for trumps; but nine times out of ten it is an unwise proclamation of trump strength. To such a pitch has foolish signalling passed, that for my own part, I decline to respond to the signal until I have become satisfied by a sufficient amount of play, that my partner knows when he ought to signal and when he ought to refrain. Pole's perfectly preposterous rule that you should always signal from five trumps,—a rule which he gives as *general* for all except strong players!—and the absurd misinterpretation of Clay's correct rule, have done more to make weak players mischievous than perhaps any thing since the modern conventions were first started. Clay's rule, which ought to act as a corrective of Pole's later absurdity, is used by many to intensify the mischief. Says Clay, correctly, you should make it a rule never to signal from less than five trumps one honour, or from four trumps two honours. The tyro adopts instead as his rule, always signal from five trumps one honour, and from four trumps two honours. Yet Clay was careful to say, in so many words, that he would by no means recommend signalling from a hand containing the specified strength in trumps. (I note here in passing that in America, Clay's negative rule, even, would not be sound; for in American Whist honours are not counted, and thus the conditions for signalling are entirely altered. When in England and Europe generally, for instance, you hold four trumps two honours, the odds are in favour of your holding, with partner, two by honours, in which case only three tricks are required—supposing the score at "love"—to win; and again, with five trumps one honour, you know that the odds are in favour of honours being either "easy" or in your favour. It should, indeed, be always remembered by Americans, in reading English books on Whist, and especially on "Short Whist," that American Whist and English Whist are different games.)

But "Pembridge" would not be justified in his opposition to the signal if the following conditions for signalling were always obeyed:—A player should only signal for trumps when, holding at least five trumps, or four headed by Ace, King, by Ace, Queen, by King, Queen, or by Queen, Knave, Ten, he has (or sees that his partner has) both length and strength in one suit, and protection in the enemy's suits, while the state of the score requires that a long suit should be established and brought in to win the game.

If there is any rule at Whist which should be regarded as absolutely general perhaps the following is one:—NEVER *signal when you want only the odd trick to win or save the game.*

It is a good rule to pay no attention to the signal unless given by a player who knows what he is doing when he signals. You will often expose yourself to the angry comments of "duffers" by declining to respond to their signals, when by accident it has chanced that they had really justification for "petering." But you must play in accordance with the chances, and it is certain that when your partner is a duffer he will signal at least five times for each single occasion when he ought to have signalled; consequently you do much more harm by responding to all his signals than by paying no attention to them, beyond regarding them as signifying a certain amount of trump strength in his hand. For, apart from the circumstance that you will only fail to answer a justified signal once in five times, there is, after all, much less harm in omitting to lead trumps when you should, than in leading trumps when you should not. It is only very seldom that omitting to lead trumps when you should has serious bad effects; but it is absolutely disastrous to lead trumps when by so doing you are playing your adversaries' game.

(To be continued.)

Our Chess Column.

BY MEPHISTO.

ILLUSTRATIVE GAME No. 1.

A COMPETING partic in the competition of the B. C. A. for the most brilliant game played in that tournament :—

RUY LOPEZ.

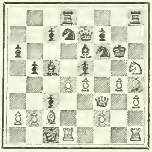
White.	Black.
1. P to K4	P to K4
2. Kt to KB3	Kt to QB3
3. B to Kt5	P to QR3
4. B to R4	Kt to B3
5. P to Q3	B to B4 (*a*)
6. P to B3	P to QKt4 (*b*)
7. B to B2	P to Q4
8. Q to K2	Castles
9. B to Kt5 (*c*)	B to K3
10. Kt to Q2	P to R3
11. B to R4	Q to K2
12. P to KR3	QR to Q sq. (*d*)
13. P to KKt4 (*e*)	P to KKt4 (*f*)
14. Kt × P (*g*)	P × Kt

BLACK.

WHITE.

White.	Black.
15. B × P	P to Q5 (*h*)
16. Kt to B sq. (*i*)	K to Kt2
17. Q to B3	Kt to Kt sq.
18. Kt to Kt3	QKt to Q2
19. Castles QR (*j*)	R to KR sq.
20. Kt to R5 (ch)	K to Kt3 (*k*)
21. B to R4	P × P (*l*)
22. P to Q4 (*m*)	P × P (ch)

BLACK.



WHITE.

White.	Black.
23. K to Kt sq.	B × QP
24. R × B	Q to B4 (*n*)
25. R to Q5	Q to K2
26. R × Kt (*o*)	R × R
27. B × Kt	Q to B4
28. B × R	B × P (ch)
29. K × B	P to Kt8(Q) (ch)
30. K × Q	Q to Kt5 (ch)
31. B to Kt3	Resigns

NOTES.

(*a*) At this point the doctors differ as to whether it is best to play 5. B to B4 or 5. P to Q3. We imagine that a disinclination to adopt a defence leading to dull and heavy play causes players to revert to 5. B to B4. The objections against 5. B to B4, however, are, in our opinion, of considerable weight. White may play B to K3. If Black exchanges Bishop's, White's centre will be strengthened. Black cannot conveniently retire his B, as in the Ginoco Piano, to Kt3, in consequence of having played P to QR3. If B to R2, White exchanges, placing Black's Rook very awkwardly. Again, White may reply with 6. P to QB3, as in the text; then by playing P to Q4 at an opportune moment, he may derive a benefit in position, while the White B is available on B2, to support the centre advance, and may ultimately become a very commanding piece by attacking the KRP. To avoid this unmasking, Black is prevented from playing P to Q4 after he has Castled. In fact, in most cases it is dangerous for Black to Castle too early, as White may get up a strong attack against Black's K's side. These are the principal objections against 5. B to B4, and, as will be seen from the game (which occurred in the Tournament of the B. C. A.), nearly all of them are exemplified here by a corresponding inferiority in Black's position.

(*b*) Necessary, in order to play P to Q4. If P to Q3, Black would have an inconvenient position, owing to his QKt being pinned, and the probability of the advance of the White QP, an inconvenience which a player ought to avoid if he can do so; at the same time, P to QKt4 brings White's B into better play.

(*c*) Of course general principles must always be subordinate to the opponents' tactics, as otherwise a player will win in spite of bad development. 9. B to Kt5 is the right move here, for if 9. B to K3, B × B, the P cannot retake, as Black could double White's P's by P × P. It may be seen here that the Black KB would be far better placed on K2.

(*d*) Here the principle as regards pinning is amply illustrated. By placing his R on Q sq. Black doubly pins his own Kt, and thereby creates another weak point in his position.

(*e*) This move is valuable as an instance of a deviation from a general rule in a particular case. The general rule being that it is advantageous to secure one's own position by Castling before proceeding to the attack, but, as stated in note *c*, circumstances alter cases. In this instance it would be somewhat inconvenient to Castle QR (it being clearly part of White's plan and to his advantage to attack Black's King's side) on account of several harassing moves which are at Black's disposal, such as P to Kt5, P to Q5, &c. Moreover, by the text move White obtains an immediate advantage in position.

(*f*) Black could not otherwise prevent White from playing P to Kt5.

(*g*) This sacrifice is possible, on account of the position of Black's Q and R, and the general aspect of the game. Similar opportunities occur in many variations of the Giuoco Piano. A thorough examination of the position is, however, required in most cases, to see whether the piece may safely be given up. Thus, for instance, if the square on Black's K3 were unoccupied, it would enable Black to play Q to K3, followed by B to K2.

(*h*) Black wanted to prevent the advance of the White QP.

(*i*) The QKt does good service on the K's side.

(*j*) White's attack being now far better developed, he may Castle more effectively and with greater security.

(*k*) Although Black would have still had a bad game, he would have done better to take the Kt with the R. In that case White would have proceeded to double the Rooks on the Kt's file.

(*l*) This brings about a speedy loss, but Black had no satisfactory move at his disposal.

(*m*) Better late than never; White seizes the opportunity which brings his B to bear on the attack.

(*n*) If P × R, then 25. P to K5 discovering check would be fatal.

(*o*) White now simply breaks up Black's game.

We have given the above game, as promised, as the first of a series of real games, in which we endeavour to explain the principles which ought to guide players in the conduct of games. We shall, however, be pleased to enter into any discussion or give further explanation upon any point in these games which appears doubtful to our readers.

CONTENTS OF No. 193.

NOTICES.

Part XLIV. (June, 1885), now ready, price 1s., post-free, 1s. 3d.

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CONTENTS OF No. 195.

THE PHILOSOPHY OF CLOTHING.

By W. MATTIEU WILLIAMS.

XIII.—A PEDESTRIAN'S OUTFIT.—TOWEL SHIRTS.

MY own experience of woollen clothing, which has been somewhat critical as regards transitions of temperature, confirms that of Rumford and the other cases already described. My first long pedestrian excursion, which extended across France, through Switzerland, and onwards through Italy, Sicily, Greece, and a little of Turkey, and occupied above twelve months, was made when I was just out of my teens, and quite a greenhorn. Starting in June, and going southward, I supposed that light clothing was the thing, and accordingly wore cotton trousers, cotton vest, a thin "Orleans cloth" coat, and linen shirts. The inconvenience of this (with no second suit, as a matter of course) soon became apparent, especially when benighted at such places as the summit of Mont Pilatus, the Grands Mulets of Mont Blanc, the Mont Mort above St. Bernard, &c. I had, however, even then learned that woollen socks were cooler than cotton for a day's walk, and afterwards read Rumford's essay and what Dr. Andrew Combe wrote on the subject. The result was a gradual modification of pedestrian outfit, culminating in that which I prepared for my trip "Through Norway with a Knapsack" in 1856. I will describe this, as it practically fulfilled my theoretical expectations.

Two soft woollen shirts of best quality, unmixed with cotton, and made to fit very loosely. Four pairs of woollen socks, thick and soft. Coat, vest, and trousers of home-spun shepherd's-plaid made in the Highlands; the coat of ordinary shooting-coat pattern and lined with coarse Welsh flannel; the vest lined with the same. Thus all was woollen material excepting at the lower part of the trousers, which were covered outside with thin leather nearly up to the knees. This addition was suggested by experience of the ragging effect of much walking upon the lower part of the trouser-legs where they rubbed together, or occasionally caught the heels of thick boots. This trouble may be escaped by wearing knickerbockers, but they are open to serious objection if garters or other ligature is used for holding up the stockings. Some of the readers of KNOWLEDGE may be able to state their practical experience as to the necessity of these. I have not tried them.

Garters are mischievous because they may obstruct the free upflow of the blood in the veins, and thus induce congestion and varicose veins below.

My boots had woollen cloth tops, thick and very broad soles, of course, with ample studding of hob nails. (These boots will be described more particularly when I come to the subject of foot clothing.) Hat of soft white felt, with very broad brim: should *now* substitute for this a Panama grass hat. I took a few linen shirt-collars, but soon threw them away as absurdities.

I had no sort of overcoat or "change" beyond the one shirt and spare socks, and had no need of such incumbrance. When the weather was cold I wore my vest, and buttoned my coat over it; when hot I removed the vest and opened the coat; when sultry I removed both coat and vest, and slung them to my knapsack. When benighted on a mountain I wore my extra shirt over my vest and trousers, wore two pairs of socks on my feet, and one on my hands as mittens. I have slept fairly well for a few hours thus on very cold nights, always selecting a bed of bare rock where crisp heather was not available, and carefully avoiding grass and ordinary vegetable soil, which is dangerous. Never sleep on the ground at the bottom of a valley. The hill slopes, though cooler, are much drier and safer.

The knapsack itself was a special invention of my own, then quite new, but now largely adopted. It was a wicker basket, lined *inside*. I had suffered great inconvenience from the confinement of the perspiration where a leather knapsack touches the back, and tried the wicker experiment with complete success.

It will be learned from this that all the clothing in the knapsack was three pairs of socks and the one off-shirt. But how about a night-shirt? is a natural and proper question. As we are now in the holiday season, and many of my readers are pedestrians, or, if not, should be, I will repeat the instructions concerning shirt manipulation which I published in the well-known story of this trip. By following these you may, with one shirt on and one shirt off, have a clean shirt every day and a change night and morning. It is managed thus:—

Suppose the hour to be 10 a.m. You have walked some distance, are getting hot, and disposed for a halt. You make for the river, lake, or the first brook or mountain torrent that crosses or approaches your path; and such are always to be found in the sort of country that pedestrians travel. Call the shirt on A, and the shirt off B. Unhook your knapsack at a cosy nook by the waterside, take out shirt B, and wash it in the stream—a very simple operation, as such a shirt, worn but one day, merely requires a little beating and wringing in the pure water, with possibly a suggestion of soap at the wrists and armpits. This done, spread out the shirt on the grass, and take your bath. By the time you are dressed, the shirt is half dry; to complete the drying, tie it to your knapsack, and let it dangle and wave behind you for an hour or two, as you walk on. Now let it be 5 p.m. of the same day. You are hot and just sufficiently tired to enjoy the luxury of repose; you retire to the adjoining field or into the forest to dress for dinner, by taking off shirt A and putting on shirt B, which is cool and fresh, and savours of the sweet, clear water of the mountain stream; you spread out shirt A to ventilate; you make up your diary, lie flat on your back, and look through the branches of the trees into the blue infinity above,

build castles in that region for half-an-hour or so, then pack up shirt A, and do the last stage of your day's walk at a swinging pace in the cool evening. Shirt A does duty as a night-shirt, B is resumed on the next morning, when A "goes to the wash," as B did the day before.

The success or failure of a pedestrian excursion of any length depends primarily on the reduction of luggage. Everybody takes too much. I did so on this occasion, having included a comb and hair-brush, besides the above-named collars. On reaching Christiania I had my hair cut. The operator used very long shears, and presently I discovered that there remained on my head nothing to brush, and less to comb. The Norwegians clip their horses annually, themselves likewise, and in the same degree. The only occasion on which I did not take an excess of luggage was on a suddenly extemporised trip through Belgium, the Rhine, Bavaria, the Tyrol, Venice, the Italian lakes, Alsace *viâ* the Splügen and Zurich, thence by the Moselle to Nancy, and from Nancy to Paris by rail. My luggage on starting from London by the Dunkirk packet was a penny sheet of brown paper and a bit of string. Every other requirement was purchased on the way as the demand arose. The natural course of evolution in this case finally converted the sheet of paper into a German satchel filled with handbooks and photographs. If you eat a raw turnip or a hard apple every morning, the supposed necessity for a tooth-brush is refuted by a *reductio ad absurdum.*

So far I have only considered clothing material in relation to its resistance to the passage of heat and the transpiration of aqueous vapour. The saline constituents of the perspiration are very variable in composition; varying with different individuals, and in the same individual at different times, according to the conditions of health, exercise, climate, and food. To these variations I attribute the contradictory results obtained by able chemists and physiologists who have collected and analysed these secretions. I will not enter upon the details of such analyses, especially as I have recently discussed them in connection with the physiology of nutrition in my papers on "The Chemistry of Cookery."

At present it is sufficient to note that there are given out either urea itself or nitrogenous salts of similar composition and physiological significance; salts which are products of the degradation of tissue, and therefore constituting excrementitious matter, which is more or less poisonous, and should be removed. The foulness of the arm-pit portion of a dirty shirt, or the feet of over-worn socks, indicate this, and prove the necessity of frequent changing of underclothing.

In reference to these, I am inclined to conclude that my towel shirts, described in the last paper (I learn that the technical name of the material is "huckaback"), are better than flannel. Flannel assists gaseous transpiration better than the towelling; but this is decidedly superior to flannel in removing the liquid perspiration, and all that it holds in solution. This may be tested by simply washing one's face, and then wiping it with flannel, as against good soft huckaback. Therefore, I conclude that persons who are troubled with excessive liquid or sensible perspiration may find the towel shirts even better than flannel. Should any of my readers repeat my experiment, they will do good service by recording the results.

The experience of furnace-men is in favour of such material. I have seen much of them, and find that the "mop," which is thrown loosely round the neck or over the shoulders, and used for wiping or mopping the face and breast, is usually of towelling material. I do not remember ever to have seen a flannel one in use, either above ground or in a coal-pit. The comfort of the huckaback shirt is unquestionable.

ILLUSIONS OF THE SENSES.

By Richard A. Proctor.

(*Continued from page* 40.)

THE sense of heat is in like manner usually associated with the sense of sight, so that illusions affecting it are either corrected or modified by visual impressions. Yet there are cases where this sense is deceived when acting alone. For instance there is the well known experiment in which after one hand has been placed for a time in water as hot as can be borne, and the other in ice-cold water, both hands are plunged simultaneously into tepid water. Immediately the hand which had been in very hot water recognises a comfortable sense of coolness, and as it were pronounces the water cold; the other hand as quickly recognises a comfortable sense of warmth and pronounces the selfsame water hot. Here even sight will not correct the illusion. We see as plainly as possible that both hands are in the same basin, yet one hand seems to be in warm water the other in cold. I find a singular effect produced if while the attention is strongly directed to the circumstance that both hands are in the same water, the hands are freely moved about in the water. For it seems then as though there were currents of hot and cold water in the same basin, moving so as to follow or rather to accompany the hands.

Without making definite experiment in this way, we can easily in the ordinary experiences of life, recognise the readiness of the heat sense to be deceived. Thus we come out of a warm room into the hall outside and find the air there pleasantly cool. We then, perhaps, see a friend home through the cold night air and presently return to the same hall. But now, coming into it from the cold outer air, we find it pleasantly warm.

Professor Le Conte remarks that "during the Arctic voyages made by Parry, Franklin, Ross, Kane, Nares, and others, it was found that a zero temperature seemed quite mild after the thermometer had been twenty or thirty degrees below that point." But, although in California temperatures of twenty or thirty degrees below zero may not be common, an American has no occasion to leave the United States, or even the middle states, to experience the illusion in question. I have repeatedly walked along the streets of New York with the temperature a degree or two below zero, without wearing an overcoat or feeling the want of one, when such a temperature has followed a few days of much colder weather. And conversely, even as I write I am feeling unpleasantly cold at Columbia, South Carolina, with the temperature only just below zero (and the air still), simply because I have been enjoying during the last few days in Charleston, S.C., a soft and balmy warmth resembling that of a June day in England.

Again in caverns like the Mammoth Cave, Kentucky, or Kent's Hole in Devonshire, there is in summer always a sense of coldness and in winter always a sense of heat, yet in reality the thermometer shows that, as might be expected, the air is somewhat warmer within such caves in summer than it is in winter. Here, then, the illusion is not only incorrect but the very contrary of the truth, the air seems colder when it is really warmer and warmer when it is really colder. Because the range of tempera-

ture is much less within the cave than in the open air, we are deceived into the idea that the temperature really ranges the reverse way from that in which it actually varies.

A more subtle illusion relating to heat is that arising from difference in the conducting power of various substances with which the skin is brought into contact. Thus if we plunge into water of the very same temperature, when tested by the thermometer, as the surrounding air, both being really cooler than the body, the water seems cold, because being a better conductor than air, it immediately begins to carry off more of the body's warmth. On the contrary, the self-same substance—water—not only feels hot but is unbearably hot when at a temperature far below that of the surrounding air in a Turkish bath.

It is to be noticed that in this case the sense of heat while in one respect leading to an erroneous idea, in another and a much more important point gives correct information. If one were to trust the teachings of the thermometer, and infer that one might as well remain in water as in air seeing that the water and the air are of the same temperature, one would make a serious mistake, and suffer a good deal of harm through the rapid abstraction of warmth from the body. The heat sense, by telling us wrongly that the water is colder than the air, conveys at least the much more important information that we are losing heat while in the water,—and therefore saves us from the danger of getting unduly chilled, as we might if we trusted to the thermometer alone. In the reverse case, the sense of heat acts even more directly and emphatically for our benefit. I remember a case in point which occurred at the Hummums. Some one who had heard that the temperature of water in the hot rooms is always much lower than the temperature of the air, but had not considered the matter with actual reference to the requirements of the human body, supposed that he would gain decidedly in comfort if instead of sitting on the non-conducting felt or flannel of the seats, he were to substitute a roll of towels well soaked in water. He found as a matter of fact that the arrangement thus suggested by the thermometer was very far from being welcomed by the nerves of touch,—whose repugnance to the arrangement was indeed most emphatic.

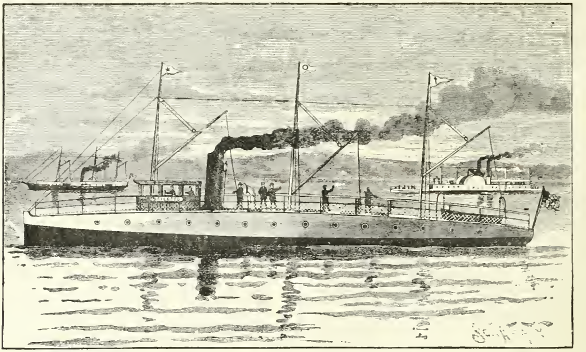
It is hardly necessary to say, perhaps, that the whole question of clothing, especially for young people, depends on the relation between the conducting powers of various substances used for clothing. In this matter the sense of heat gives more trustworthy information than the thermometer, clothes which seem to be of the same temperature if tested by the thermometer affording very different degrees of protection against the loss or the too rapid accession of heat.

In passing, I may note here an important consideration as to the clothing proper for children. In their case as in the case of grown folk the sense of heat gives the best information as to what is really desirable in the way of clothing. But grown people are apt to forget the experiences of their childhood, and to decide what is best for children from their own ideas as to what ought to be best. A child complains of cold or of heat sooner than a grown person; but much less attention is paid to the complaints of children on such matters than to our own slightest suggestions of personal discomfort. And children are much less carefully guarded against heat and cold than grown persons guard themselves. The idea seems to be that children can stand any changes of temperature; though, oddly enough, children's own idea (which is really not very far from the truth) that they can stand anything in the way of rich and indigestible eating, is not much considered by older persons. Now when a child shows by its words or actions that it suffers sooner from changes of temperature than grown people do, it in reality expresses its sense of an important truth. A child cools and warms more quickly than a man; for precisely the same reason that a small cinder cools more quickly than a large one, or that a small fire burns out more quickly than a large furnace. Compare the case of a child three feet high with that of a man six feet high. Neglecting slight differences of build, the man is about eight times as large as the child, or contains eight times as much matter. But the surface of the man is not eight times as large as the surface of the child; it is only four times as large. Thus supposing the man and the child to come out of a warm room into the cold outer air, being both at the same temperature, the man has eight times as much heat to part with as the child has; but he only parts with four times as much heat, moment by moment, if he and the child are similarly clothed. Thus the child's loss of heat, moment by moment, though only one-fourth of the man's loss of heat, bears twice as great a ratio to the child's total supply of heat. The child will cool as much in one minute as the man cools in two minutes, or in half-an-hour as the man cools in an hour. If the weather outside is so cold that the man would suffer serious injury to his health after an hour's exposure to it, the child will suffer at least an equal injury in half-an-hour. In reality of course the child will suffer a greater injury; because apart from his more rapid loss of heat, the child's flesh is more tender and necessarily suffers more from a given loss of temperature. Similar remarks apply to increase of heat, which may be just as mischievous as access of cold. Yet we are too apt to clothe children with total disregard to the circumstance that they require to be protected much more carefully than their elders against rapid changes of temperature. Apart from all questions of propriety a man would not care even on a fairly warm spring day to go about with his arms and legs bare for any length of time; for he would feel uncomfortably cool: children suffer twice as much on such a day from undue exposure to the air; yet many foolish folk think nothing of exposing the delicate limbs of children to the cold of winter without protection. They imagine that the numbness and insensibility which really indicate the mischievous effects of the cold, and may permanently affect the child's constitution, are signs of hardening; and because only the hardier survive this cruel treatment they imagine that those hardy survivors owe the strength which enabled them to survive, to the harsh exposures by which that strength was dangerously taxed and perhaps in large measure sapped.

(To be continued.)

The "Visitation of Dorsetshire," and the "Visitation of Gloucestershire" of 1623, have just been issued by Messrs. Mitchell and Hughes to the Members of the Harleian Society. The two volumes are included in the subscription for 1885; and the second volume of the Registers of St. James, Clerkenwell, will be ready for the Members in August.

Burnham Beeches.—In a special "Holiday Edition" of Mr. Francis George Heath's "Burnham Beeches," to be published immediately by Messrs. Rider & Son, of Bartholomew-close, will be included a portrait of the author, upon whose suggestion this charming tract of forest was secured for public use by the Corporation of London.



A FAST STEAM-YACHT.

FOR more than twenty-two years the side-wheel steamboat *Mary Powell* has been recognised as the fastest boat on the Hudson River; she makes an average of twenty miles an hour, and according to a pamphlet issued by the owners, "in the year 1882, she ran at the very fast rate of 26 miles an hour between Milton and Poughkeepsie, making the four miles in nine minutes." Boats of all sorts of shapes, big and little, side-wheels and propellers, have unsuccessfully attempted to wrest from her the well-earned title of Queen of the Hudson. But on June 10 she was badly beaten in a long run by a small steam-yacht of very insignificant appearance. The run was from this city to Sing Sing, a distance of 30 miles, and was made by the steam-yacht *Stiletto* in one hour and fifteen minutes, the *Mary Powell*, on her regular trip to Rondout, being beaten about two miles.

The *Stiletto* was designed and built by the Herreshoff Manufacturing Co., of Bristol, Rhode Island. She is 94 ft. long over all, 90 ft. on the water-line, and 11 ft. beam. The hull is double planked, and sharp at both ends, the curves extending far toward the centre. A slightly arched deck covers the whole boat. Forward is a pilot-house sufficiently large to serve as a commodious cabin. Owing to the extremely small space taken up by the engine and boiler rooms, there is ample room for comfortable quarters for the crew and state-rooms for the owner, guests, and officers. Power is furnished by a compound condensing-engine of 12-inch stroke and cylinders 12 and 21 in. in diameter; the engine is supplied by a sectional water-tube boiler, in which steam can be got up quickly, and which is calculated at 450 horse-power. Although this boiler is similar in principle and operation to those of the regular Herreshoff type, it varies greatly in construction, the tubes being arranged horizontally in sets immediately over the fire—each set being at right angles to those just above it. Exhaust steam is led to a surface condenser. An ordinary pump takes the water from the condenser, forces it into the upper set of boiler tubes, through the boiler to a separator located in front of the boiler, and to which the steam-pipe is connected. The boiler will work safely with 160 lb. of steam, but in the race with the *Mary Powell* it was only found necessary to use from 120 to 125 lb. The fire-box is $6\frac{1}{4}$ ft. square.

The screw is four-bladed, 4 ft. in diameter, and $6\frac{1}{2}$ ft. pitch. At the stern the boat draws $4\frac{1}{2}$ ft., and at the bows 3 ft. We may notice that there are now building at the yards of Yarrow & Co., England, two torpedo boats which are expected to run, when light, at the rate of 24 knots an hour, or nearly 28 miles. The *Stiletto* must do better than 25 miles an hour before she can claim the broad title of the fastest boat in the world.—*Scientific American.*

THE RUDDY ECLIPSE OF THE MOON.

By RICHARD A. PROCTOR.

(*Continued from page* 47.)

IF we consider what really happens when (as supposed to be seen from the moon) the sun is passing behind the earth, and therefore the earth's shadow is thrown on the moon, we shall readily understand the increase of the earth's effective shadow-throwing diameter by about one-sixtieth part,—a circumstance which some so strangely misinterpret,* that they appear to imagine a range of 60 or 70 miles of our atmosphere above the sea-level to play a part in determining the phenomena of a total lunar eclipse!

Suppose E S E′, Fig. 1, the face of the sun when the outline of the earth E C E′ passes through C the centre of the sun's disc, k K k', l L l', m M m', and e S e' being the advancing edge of the earth at equidistant times up to the summit of geometrical totality. Then obviously, as

* The mistake is very commonly made of attributing this increase to the earth's atmosphere. In reality the earth's atmosphere has nothing to do with it.

indeed Mr. Ranyard has partly indicated, the degradation of light is more rapid as the earth approaches S, because not only are the crescents of visible disc diminishing more and more rapidly, but the average lustre of the visible

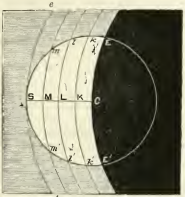


Fig 1.

portion is also rapidly diminishing. If we drew, as in Fig. 2, a diagram, such that, O X and O Y being axes, O C, O K, O L, and O M represented the breadths S C, S K, S L, and S M of Fig. 1, then if the illumination received when the earth's edge is at C, Fig. 1, were represented by the ordinate C c, Fig. 2, the illumination when the earth's edge reached K, L, M, Fig. 1 would be represented by such ordinates as K k, L l, M m. Here O M would correspond to about 4′. Suppose, now, another diagram made, as in Fig. 3, in which O M represents the O M of Fig. 2, enlarged, and M m represents the ordinate M m of Fig. 2, enlarged in much greater degree. Then the earth's further progress as S M of Fig. 1 is traversed, minute (of arc) after minute, carries the edge to the points P, Q, R, Fig. 3. The illumination-ordinates shorten now much more quickly than those in Fig. 2. We get such a curve as $m\,p\,q\,r$, where Q q is less than a fourth of M m, but R r less than a tenth of Q q (the real proportions are probably somewhere about this). We see then that if s S s', Fig. 4, represent a part of the edge of the geometrical shadow of the earth on

Fig. 2.

Fig. 3.

Fig. 4.

the moon, r R r' and q Q q' rings respectively 1′ and 2′ from that shadow, the average illumination over the area q R q' is greater than that over the area r S r', somewhat as the area R r q Q in Fig. 3 is greater than the area O R r. Now if O $r\,q\,p\,m$ in Fig. 3 were a parabola, the area R r q Q would be seven times O R r. But we have seen that in passing from M to O we get ordinates shortening far more rapidly the nearer we draw to O. Hence the illumination of q R q' exceeds the illumination of r S r' in far greater degree than this,—probably (as I find from a construction based on a fair estimate of the degradation of the sun's lustre near the edge) at least a hundred times. We cannot wonder, then, that to ordinary eye-sight (that is, regarding the eye as measuring the light without photometric aid, though aided of course by the telescope) the transition from light to darkness is so rapid that all within the circle r R r' appears dark and all within q R q' appears light. The glare from the rest of the moon's surface helps still further to deceive the eye; as we learn from the sudden change of aspect when that glare is gone,—the part within s S s' which had seemed nearly black, appearing thereafter (if refraction sends any light to it, as ordinarily happens) to glow with a considerable amount of ruddy lustre.

Mr. Ranyard's remarks about refraction diminishing the area of the shadow seem based on the mistake to which I have already adverted, by which he has apparently overlooked the exceeding narrowness of the atmospheric zone which can refract the sun's light into the shadowed region. If we could consider, as he seems to do, the amount of refraction to indicate the degree to which the shadow might be diminished, then indeed the perplexities into which he seems to have involved himself might be understood. But as a matter of fact (or of calculation, if that be preferred) refraction even though effective to the very sea-level all round the earth's disc as seen from the moon, cannot affect the shadow's *size* in the slightest degree. The size of the shadow depends on the position of the ring (see Fig. 4) at which the degradation of light is so rapid that the eye recognises a marked and sudden darkening; and this, as we have seen, must occur somewhere outside the geometrical shadow. (The question is rather physiological, though, than physical.) Refraction can temper the darkness of the umbra, but cannot in any way affect its size. All over the umbra refraction is at work, usually with tolerable uniformity, carrying a certain small proportion of sunlight, variously coloured according to atmospheric conditions, to illuminate the moon's surface. If one part of this surface is illuminated by a longer arc, or by an entire ring, than another, this other is illuminated by a broader and brighter one. All parts get nearly the same amount of light—at least, the absolute difference is everywhere very small compared with even the difference between the illumination along r R r', Fig. 4, and that along s S s'.

So soon as no direct light from the sun falls on the moon, and only refraction—even the most effective refraction—can carry light to her surface, we have necessarily a very feeble light indeed,—even though, as I showed (or rather explained) in my former papers, the light then received is true sunlight, not merely light from our illuminated air, as Mr. Williams supposed.

Compare, for instance, the light received from a crescent of the sun 1′ wide as seen from the moon, with the light from the complete ring round the earth into which the sun is distorted when centrally behind the earth, the zone of atmosphere bordering the earth's disc being supposed two-thirds clear of clouds down to the sea-level and of its average transparency. I take the average brightness of the crescent of sunlight to be about one-fifth the average brightness of the solar disc, and the area of the crescent about 1-700th part of this disc. I also assume the average absorption of sunlight in passing through our atmosphere grazingly between altitudes 0 and two and a half miles to be 19-20ths, the ordinary coppery light of the totally eclipsed being such as to suggest at least this amount of absorption, and the real

absorption being probably considerably greater. We have then to compare two illuminations, one from an apparent surface equal to 1-700th of the sun's and of an average intrinsic lustre equal to one-fifth of his; the other from an apparent surface corresponding to two-thirds of a ring around the earth's disc, about two and a half miles in width and of only 1-20th the sun's intrinsic lustre. Now the apparent size of this ring round the earth, as seen from the moon, has been shown (see Knowledge for April 24, 1885, p. 341) to be 1-889th of the sun's apparent disc. Hence the ratio we require is

$$\frac{1}{700}\times\frac{1}{5} : \frac{1}{889}\times\frac{1}{20}\times\frac{2}{3}$$

or 5334 : 700, *i.e.*, nearly 8 to 1.

Yet we have seen that along r R r', Fig. 4, or 1′ from the edge of the geometrical shadow, the eye recognises so great a loss of light that the shadow seems to occupy the space r S r'; how little then can any part of the shadow within s S s' be affected by the small modicum of refracted light which can fall there, even under conditions rather more favourable than usually exist.

I have not thought it necessary so far to take special account of the action of the higher layers of the air, in bringing light within the geometrical shadow. This action has to be considered in two aspects. In the first

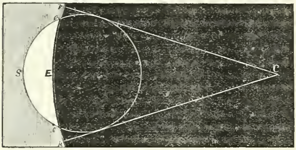


Fig. 5.

place it increases, so far as it is effective at all compared with direct light from the sun, the amount of light falling outside s S s' Fig. 4. For so soon as the sun even begins to pass behind the earth, as seen from the moon, refraction is at work in bringing the geometrically hidden parts of his disc into view. But such parts must necessarily be *intensely flattened*—so to speak, and the amount of light reaching the moon through such refractive action must always be very small compared with that which arrives directly, so long as any part of the sun's face remains unconcealed (geometrically) by the earth.

Suppose, for instance, three-fourths of the sun's diameter covered, geometrically. Then the sun as seen from the moon would be wholly visible, in the shape shown in Fig. 5, the part really behind the earth being compressed into a thin zone along e E e', the inner edge of this zone being raised a mile or so above the earth's true outline. (It would only reach this when the sun had passed so far into the shadow that only actual grazing refraction would bring him into view.) Beyond e and e' would be two fine arcs of light extending to k and k', where lines from C the centre of the earth's shadow touch the disc of the sun. The centre of the sun being about 8′ below (or rather within) E would be raised into view by the action of that layer of air which for an observer on earth would produce a horizontal refractive of 4′, about one eighth of the horizontal refraction at the sea-level. This would correspond to an elevation of about $11\frac{1}{2}$ miles. The atmosphere 14 miles above the sea-level would bring up only about 4′ of sun breadth; the atmosphere $17\frac{1}{2}$ miles high only about 2′. Now it takes a depth of nearly 70 miles of our atmosphere to subtend 1′ at the moon's distance. So that the zone bringing any appreciable amount of refracted light, would be very narrow indeed.

Probably I am far within the truth in saying that if the sun had just set geometrically behind the earth, while the part of his disc farthest in would appear about three-quarters of a mile above the sea-level, the part just within (geometrically) would not be apparently raised more than twenty miles above the sea-level by the refractive action of that portion of the air effective in bringing it into view. The illumination derived from the meniscus arc of light so showing would be very small compared with full sunlight—possibly about 1-10,000th part on the average. In colour it would be but slightly tinged with red, under ordinary conditions,—so slightly that probably by comparison with parts of the moon further within the earth's geometrical shadow, illuminated by ruddier light, this portion would look slightly bluish. It would be a very narrow zone of shadow, however.

THOUGHT AND LANGUAGE.

By Ada S. Ballin.

XIII.

We have seen that the deaf-mute thinks and reasons and finds a means for expressing his thoughts; but we have not yet touched upon the question of *how* he thinks. The question of the manner in which thought proceeds is one of great interest, but it is one to which very little attention is paid except by psychologists. If an intelligent and well-educated person, with all his senses intact, is asked the usual form of his thoughts, he will generally be at a loss what to answer, and this arises from the fact that, as a rule, we think, but are not conscious of the act of thinking, and pay no attention to it. If, however, we do turn our attention inwards we find that for the most part we think in imaginary sounds. As Goethe says, man is a creature of custom:—

> Aus der Gemeine ist der Mensch
> Und die Gewohnheit nennt er seine Amme.

We are so accustomed to express our thoughts in certain varied groups of sounds which we call words, that we chiefly think, as it were, in suppressed sounds or words. It is this fact that led to the confusion of thought with speech among the ancients, who held that thought and speech are identical, except that thought "is the unuttered conversation of the soul with itself, and that the stream of thought which flows through the lips and is audible is called speech," according to Plato's summary of the matter in the "Sophist."

If we look closely into the question we find that thought and language are by no means identical, although so closely associated by habit. For example, the same thought may be expressed in half-a-dozen different ways, and we select that which seems most suitable to us, while at other times a thought presents itself to the mind and we find the greatest possible difficulty in clothing it with words. Further, while all nations have to a great extent the same thoughts, each has a different way of expressing them. I have previously compared words to coins which take the place of articles alike cumbrous for transportation or storage; and, in fact, they are handy

counters by which the exchange of our ideas is facilitated, and by which we are enabled to store in the mind a much larger number of thoughts than would otherwise be possible, and to pass with much greater rapidity from one to another. Hence, we habitually think in words (suppressed sounds), a habit based upon convenience; but we also think to a large extent in visual images and imaginary movements; and this mode of thought is particularly noticeable in our dreams. This is the mode in which the lower animals think, and when a dog starts up in his sleep with bristling hair and barks, the inference is not unjustifiable that he is dreaming of combat with some imaginary enemy. There is such a thing as abstraction by way of visual or generic image—that is to say, simple concepts may be formed by visualisation of similarities, and there is every reason to believe that animals possess this power of abstraction, as I have already shown. They abstract qualities common to various individuals; the dog has an abstract idea *cat*, as something possessing certain qualities which are obnoxious to him, and render the possessor a fit subject for him to persecute; and so with other animals whose ideas embrace not only individuals but also classes, they perceive resemblances and differences, and are thus enabled to recognise individuals as belonging to this or that class. Like the deaf-mute, the ordinary child begins thinking by this visual representation, and it is in this way that the deaf make their imitative signs. The visual images of these signs afterwards take their place in the mind as convenient representatives of thoughts, just as the audible images of words do in the minds of hearing people.

"There is nothing in mind which was not previously in sense," and the first thoughts are imaginary sensations. These sensations are grouped together, and form what the psychologists call percepts. Afterwards the percepts are associated with the expressions or symbols used to communicate them. Thus, hearing people, who are accustomed to express themselves in words, think generally in sounds, but frequently in visual images; while the deaf-mute generally thinks in visual images; and those who are both deaf and blind, in touches, tastes, and smells. As thought is primarily carried on in terms of sense, when one sense is cut off the others attain proportionately-increased activity.

Kruse, who was himself deaf and dumb, writing* about the mental development of his companions in affliction, says that the qualities which in his mind constitute the difference between things when he imitates objects and actions for the purposes of communication, become suitable marks which serve to fix them in his mind, so that he can memorise and recall them, and the signs thus become the means of thought.

On this point I have questioned several young people educated on the oral system, who, being perfectly deaf, have no idea whatever of anything like sound. At first my questions were misunderstood, and all asserted that they thought in words as we do. The hearing teachers also affirmed this of their pupils, and it was only with difficulty that I could make clear to them that, since our mode of thinking in words is simply thinking in sounds, it was impossible that the congenitally deaf could think in this way. After minute questioning, a fairly intelligent girl, 18 years old, maintained that she ordinarily thinks in signs or imaginary actions. That when she thinks of anything in reference to the deaf and dumb, she thinks in actions; but that when she thinks of hearing people, she thinks in words—that is to say, in certain groups of movements of the vocal organs, *not* in words as written or printed, although she reads and writes extremely well. A bright deaf boy of fourteen, taught on the oral system, told me that he thinks in words as spoken by himself, which means, of course, in certain groups of movements by which he is accustomed to express himself, but which we interpret by the sounds produced. Several others agreed that they think in the same way, but that the thought appears sometimes as written, sometimes as spoken by them or by other people. When they think of words as spoken by the mouth of another that person is the one with whom they chiefly converse, generally the teacher, which again illustrates the force of habit in regulating the mode of thought.

* "Ueber die Taubstummen."

The form of dreams is important in illustrating the habitual mode of thought: thus it is believed that animals think and dream in visual images. In the dreams of those deaf and dumb who are taught on the old system of dactylology finger-twists play a large part. When Laura Bridgeman was asleep her fingers were frequently seen moving as in animated conversation, and deaf children taught on the oral system speak in their dreams. Thoughts are not bound down to any one set of signs, whether verbal or otherwise; but certain signs, which to the thinker are marks, mental shorthand notes, so to speak, are adopted in preference to others, owing to custom and convenience. A man cannot be said to know a foreign language thoroughly until he comes to think in its forms, instead of merely translating into them his thoughts from his native tongue. When he has accomplished the former, he will have so thoroughly assimilated the foreign tongue that he will dream in it. A French gentleman resident in England tells me that, for the first twenty years of his residence, he always dreamed in French, but that he now habitually dreams in English, the habit of thought of his later life having overcome that of his youth.

Although thought in its higher phases is to a great extent dependent upon language by means of which it is chiefly developed, thought must historically be anterior to language. Generals and particulars are apprehended, comparisons, distinctions, and inferences, made remembered, and applied without the use of language both by the lower animals and by men.

The case is clearly and humorously stated by Professor Whitney, who says: "To maintain that the idea waits for its generation until the sign is ready, or that the generation of the idea and of the sign is a simple and indivisible process, is much the same thing as to hold, since infants cannot thrive in this climate without clothing and shelter, that no child is or can be born until a *layette* and nursery are ready for its use, or that along with each child are born its swaddling-clothes and its cradle." * He continues: "The mental act is momentary, its formulation in words occupies time; we have our thought to start with and then go on to give it deliberate expression. The operation of thinking in words is a double one; it consists of thinking and of putting the thought into words; we conceive the thought and conceive also its expression. That when we turn our attention full upon our own minds, we read there the act and its expression together does not necessarily prove more than the intimacy of the association we have established between our conceptions and their signs, and the power over us of the habit of expression. Every

* Whitney's "Language and the Study of Language," p. 412.

deliberate thought doubtless goes through the mind of the deaf-mute accompanied by an image of the dactylic writhings which would be his natural mode of expressing it;* but his mental action is not slavishly dependent upon such an external auxiliary."

That we deliberately clothe our thoughts in words according to the double process here described is undoubtedly true of a great number of thoughts; but in a vast number of cases words are present in the mind as marks of thoughts which it is unnecessary to call up in full, and these words are used as stepping-stones from one reasoning to another.

FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.

INEFFICACY OF THE EUCALYPTUS.—Notwithstanding the positive statements that have been made as to the suitability and value of plantations of *Eucalyptus globulus* in swampy and marshy districts, some scepticism has been manifested upon the point, and some time since a paper attributed anything but favourable results to the experiments made in this direction in Italy. In a recent report on the Lucknow Horticultural Gardens (*Gard. Chron.*) Dr. Bonavia records a similar experience, and expresses a wonder that the tree should have ever been thought suited for the purpose for which it has been claimed to be efficacious.—*Medical Press and Circular*.

* "Indeed, I know that the children of the late Principal of the Hartford Deaf and Dumb Asylum, who had grown up in the asylum, and knew the peculiar language of the inmates as familiarly as their English, could always tell what their father was thinking of, as he walked up and down in meditation, by watching his hands: his fingers involuntarily formed the signs which were associated in his mind with his subjects of thought; while, at the same time, doubtless, he imagined also their spoken signs" (p. 213).

LIGHTNING.

By W. Slingo.

MR. PROCTOR, in his "Gossip" a fortnight since, demonstrated very simply and clearly the inability of an observer to determine the direction, whether from cloud to earth or earth to cloud, of a lightning flash. This is a fact the truth of which I anticipated, although I did not essay to prove it, in my article on "The History of a Lightning Flash" (KNOWLEDGE, No. 146.) I might now, perhaps, venture on a presentation of the proof in a manner differing from the process adopted by Mr. Proctor, but I take it that such a course is, under the circumstances, unnecessary.

There still remains, however, the question, Can or does, a lightning-flash strike upwards? This question I in part answered in the above-mentioned article, by observing that "it is just as likely that a discharge may travel upwards as downwards." It is to present an answer to this question that I am now writing.

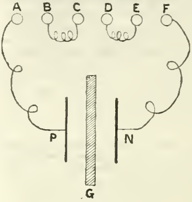


Fig. 1.

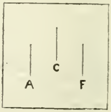
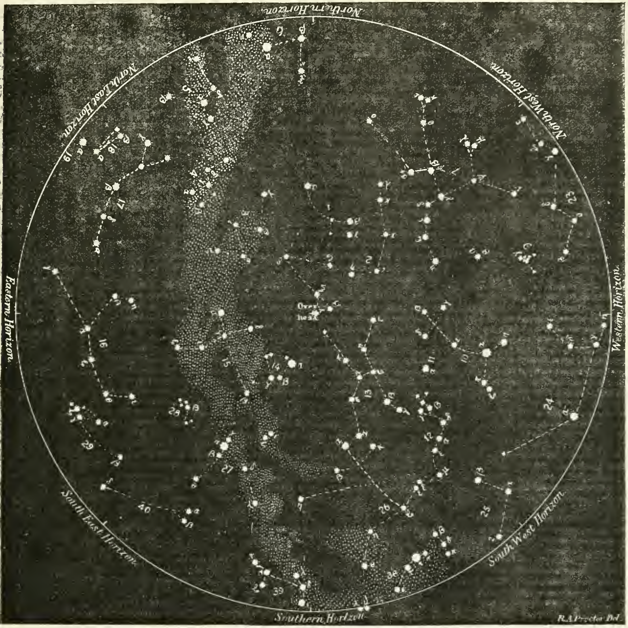


Fig. 2.

In the first place, we are aware that the atmosphere is sometimes positively, at other times negatively, charged. If, therefore, we determine in our own minds that the discharge can only take place in one direction, positive to negative, or, conversely, negative to positive, then it is clear we must concede the possibility of a discharge *from* the earth as well as *to* it. Now, however great may be our reverence for the single or double fluid theories, neither of them is capable of helping us. By the single-fluid theory, the discharge should always be in one direction (electrically speaking). But the adherents of this theory are unable to determine to their own satisfaction whether the plus or surcharge exists in the positive or negative state. While it has generally been claimed that a positively electrified body has an excessive charge, there are not wanting those who maintain that this excessive charge belongs to the negatively electrified body. By the double-fluid theory we are asked to believe that when a discharge takes place it is accomplished by the mutual exchange of a portion of the charge on each of the oppositely electrified bodies. Now this would mean that a discharge of positive electricity should take place from the positively to the negatively charged body, and that at the same time a discharge of negative electricity should travel from the negatively to the positively charged body. This, if it means anything, means that two distinct discharges, starting simultaneously from the two charged bodies, are necessary to produce a state of neutrality. But, inasmuch as the performance of work



NIGHT SKY FOR JULY (SECOND MAP OF PAIR),

Showing the heavens as they appear at the following hours:—

July 16 at 10¼ o'clock.	**July 27 at 9½ o'clock.**	**August 8 at 8¾ o'clock.**
July 20 at 10 o'clock.	**July 31 at 9¼ o'clock.**	**August 12 at 8½ o'clock.**
July 24 at 9¾ o'clock.	**August 4 at 9 o'clock.**	

is inseparable from time, small though the lapse of time may be, it follows that the loss of, say, positive electricity on the positively excited body would not coincide exactly with the accession of the corresponding amount of electricity necessary to produce neutrality. In other words, when the two bodies are separated by a medium of considerable extent, there should, at each surface, be two flashes of light travelling in opposite directions and capable (with the aid of suitable apparatus) of being distinguished.

Let us call to our aid the (what I may style classical) experiment of Sir Charles Wheatstone. The accompanying diagrams illustrate the experiment. P and N (Fig. 1) are two pieces of metal separated by a glass plate or other insulating substance, G. Wheatstone used a Leyden jar, his object being to ascertain the speed at which electricity travelled. But any other form of condenser will answer equally well. Let us conceive the metal plate P to be charged positively, and connected to the ball A, while the plate N is charged negatively, and connected to the ball F. Close to A, but not touching it, is the ball B, which is connected to the ball C by means of a quarter of a mile of wire. Close to C, but not touching it, is another ball D, which is likewise connected, by means of a similar length of wire, to the ball E. This, in its turn, is placed close to, but not touching, F. There are thus three pairs of balls, and in the event, therefore, of the charged plates P N being

discharged, three sparks will be seen between these balls. Looked at under ordinary conditions, the three sparks will appear simultaneously.

Opposite the balls, however, was placed a revolving mirror, making 800 revolutions per second, and the images of the sparks received by it were reflected on to a screen. It was observed on discharging that the images appeared in the manner shown in Fig. 2, A and F being simultaneous, while C was a little later. The retardation of the middle line or spark was calculated to amount to one 1,152,000th of a second; that is to say, this was the time taken by the discharge to traverse the quarter of a mile of wire between B and C or E and D, corresponding, *in this particular case*, to a velocity of 288,000 miles per second. From the lengths of the arcs, which were in all three cases identical, it was calculated that the duration of each spark was one 24,000th of a second. Had the discharge travelled from the positive plate P to the negative plate N, then a flash of lightning would have been seen pictured on the screen between each pair of balls, that between A and B occurring first, and the other two following in rapid succession. Had the discharge started at the negative plate the flashes would have been seen in the reverse order. Had there been (on the double-fluid hypothesis) a mutual exchange, Wheatstone would have observed, not three, but at least five sparks pictured, two occurring between A and B, two between F and E, and one between C and D.

The evident teaching of this experiment is that a lightning discharge *may* start from earth and cloud *simultaneously*, meeting at some central point. But are we justified in inferring that it always does so? I think not. I rather imagine that in the majority of cases the conditions are not altogether comparable with those of the experiment. The whole matter turns upon the question of electrical "tension," a term which may be defined as the tendency to produce an electrical discharge. Where, over a given area, there is the greater concentration of electricity, there will be, perforce, the greater tension. The distribution of electricity on a conductor is rarely uniform, varying very considerably with the shape. Where the greater prominences occur, there will be found the greater concentration of electricity, whence it is said that electricity accumulates at points; and it is well known to the merest tyro in electrical science that this concentration at points results in a proportionally increased tendency to produce a discharge. If, then, a certain quantity of electricity is confined to a cloud, and that quantity, acting inductively upon the subjacent earth, produces an equal degree of electrification (of the opposite kind), it follows that, in the majority of cases, the charge on the cloud will be at a greater tension than that on the earth, for the simple reason that, more often than not, the cloud is more pointed or irregular in shape than the earth. As a matter of fact, the terrestrial charge is more or less uniformly distributed throughout the neighbourhood, while in the cloud there is a considerable concentration at the edge or pointed portion. Whence it ensues that, in the majority of cases, there is great reason to suppose that the discharge strikes downwards only. On the other hand, were the terrestrial surface provided with but a single point, such as is furnished by the well-known lightning protector, the discharge would only take place upwards. Moreover, the discharge would be a gradual, or, within certain limits, a continuous one, because the tension would grow so rapidly (as the cloud approached) that it would be quite incapable of retaining the charge. Had Wheatstone been able so to modify his experiment as to place at A or F a huge sphere, or even a plate instead of a small ball, and, conversely, to substitute for F or A a still smaller ball approaching even a point, there is to my mind little doubt but that he would have seen a different result. He would in all probability have obtained the sparks *in succession*, that near the small ball first, followed by one in the centre, and another striking the large surface. Now neither the single nor the double-fluid theories can adequately account for this.

We may, however, regard the charged cloud and the subjacent electrified earth as the extremities of a long elastic chain of electrically-polarised particles, each subjected to a series of stresses increasing in strength until it is compelled to yield. This chain, indeed, strives to shorten itself, and it is this striving that we know as electrical attraction. With the necessary facilities this shortening takes place, chief amongst these facilities being the physical elasticity or mobility of the intervening substance (or di-electric)—in this case, air—and the low electrical capacity of the charged bodies.*

We may compare the polarised chain to a rod of extended elastic held at the extremities until the extension is sufficiently great to overcome the holding or restraining power. If two oppositely-charged bodies have equal capacity, we can conceive that, when the discharge occurs, it will bear some resemblance to a piece of extended elastic set free at both ends simultaneously. This is exactly what happened in Wheatstone's experiment. Where the two bodies have different capacities, we may compare the polarised chain to a piece of elastic held more firmly at one end than at the other, whence it follows that the contraction will be one-ended, that which is less securely held corresponding to a charged body of small capacity, and which, therefore, speedily attains to the tension necessary to produce discharge.

In conclusion, then, the lightning discharge may take place (i.) simultaneously from earth to cloud and cloud to earth, (ii.) from earth to cloud, (iii.) from cloud to earth. The first form happens when the configuration of earth and cloud are (electrically) similar; the second when the earth is sharper than the cloud; the third when the cloud is more pointed than the earth, and it is this third form which I think most frequently ensues.

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

FROM NUNEATON TO TAMWORTH—THE WARWICKSHIRE COAL-FIELD.

(*Continued from p.* 21.)

But we have not yet seen the finest exposure of the Cambrian shales. If, on leaving Hartshill, we direct our steps in a south-westerly direction to Stockingford Station (2½ miles), and then walk along the Midland line to Nuneaton, the following facts may be observed. Soon after leaving the station we note on the left-hand side of the line a large brick-pit, showing coal-measure shales and sandstones dipping at high angles to the south-west, and much disturbed, indicative of a fault (missed by the surveyors), which runs between the coal-measures and the Cambrian beds beneath. This line of

* Capacity is measured by the quantity of electricity required to raise the charge on a conductor to a given potential. A body which has the highest capacity is that which combines minimum surface with maximum content, viz., a sphere. In a body having, therefore, large capacity we should get low potential.

fault is actually indicated on the surface by the number of brick-pits which work the "fault-stuff," as the rubbed-up clayey matter between the two sets of rocks may be called; moreover, all the diorite bands end abruptly against it. Proceeding eastward, we enter a cutting in which the Cambrian shales are capitally exposed. They consist of grey, black, and purple to red shales—the latter lying at the base. They dip to the south-west at from 55° to 65°, and the height of the cutting is from 20 ft. to 30 ft. Nodules of manganese occur in the red shales, and they were formerly worked for this mineral at several points near Nuneaton and Hartshill. Fossils occur in the shales, but they are indistinct and difficult to find. The commonest shells are small species of *Lingulella* and *Obolella*, and with these are trilobites of the genus *Agnostus*. The collection of life-forms—such as it is—appears to place the strata near the base of the *Tremadoc Slates*—a division of the Upper Cambrian formation finely developed in North Wales. If this correlation be correct, the Hartshill quartzite probably represents some portion of the *Lingula flags*, which in Wales lie below the Tremadoc slates, just as the Hartshill quartzite lies below the Stockingford shales.

South of Nuneaton the quartzite is not seen, but the overlying shales can be traced past Chilvers Coton through Griffin Hollow to Marston Jabet. At the latter village—in an old quarry near the Hall—the shales are seen to dip *east*, at a low angle. They are here traversed by an intrusive mass of diorite, which forms two large bosses north-west of Marston Hall. The same easterly dip is found at the other end of the strip of Cambrian strata, north-west of Atherstone, where the beds—coal-seams and all—roll over and dip to the east.

Thus the north-east border of the Warwickshire coal-field is formed by a narrow fringe of Cambrian and Pre-Cambrian strata, which rise up sharply from beneath the Coal-Measures (from which they are separated by a line of fault), and occupy a tract of country nine or ten miles long by from half-a-mile to a mile in width. The structure of the region is that of an anticlinal, broken through by a fault in the centre, between Nuneaton and Atherstone, but preserving its crest to the south and to the north of these towns.

So far we have been concerned only with the eastern side of the Warwickshire coal-field. It is now time to turn our attention to the western boundary, the distance between the two being only from four to six miles. (Fig. 2.) The line from Birmingham to Derby runs parallel to the western outcrop of the coal-seams, and by walking from Kingsbury to Fazeley (little stations, the former five and the latter a mile or so, south of Tamworth), the principal facts can be seen in a few hours.

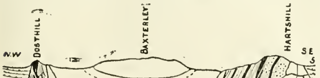


Fig. 2.—Section across the Warwickshire Coal-field, from Hartshill to Dosthill. 1. Pre-Cambrian Rocks; 2. Cambrian Quartzite; 3. Cambrian Shales; 4. Coal-measures—the dotted line shows the position of the limestone band; 5. Red Marls of the Trias.

From Kingsbury we walk northward for a mile along the line, over the new red marls, which are separated by a fault from the Coal-measures. The latter are well exposed in a long cutting, in which five distinct seams of coal can be recognised as black stripes between the beds of blue shale and sandstone. The strata dip eastward at a very high angle—70° to 80°—so that in several of the collieries the coal-seams have been followed from their outcrop almost vertically downwards to a considerable depth. The colliery-workings follow the coal-seams eastward, but in a westerly direction the lowest seam is broken and lost against the Cambrian strata, which here, as on the eastern boundary of the coal-field, have been thrust up along a line of fault. After examining the railway-cutting—which is entirely through the coal-measures—we turn to the left (westward) to study the Cambrian strata at Dosthill. Here there are several exposures in field-pits, brick-works, &c., of grey and black shales, which are traversed by countless numbers of worm-borings, so that one is tempted to refer the strata to the "annelidean stage" of the Cambrian epoch. The river Tame flows from south to north through alluvial flats along the western foot of the bold short ridge on which the village of Dosthill stands. The hard, dioritic rock rises so abruptly from the stream-course that at places the hill-side is nearly vertical; other igneous rocks here are dykes of a greyish decomposed rock, similar to those near Nuneaton. In a field-pit quite close to the high-road (on the west side), three-quarters of a mile due south of Dosthill Church, there is a very interesting section, showing a "neck" of igneous rock rising through the shales, and then spreading over them in all directions. In this respect, it is almost unique in the Midland counties (Fig. 3).

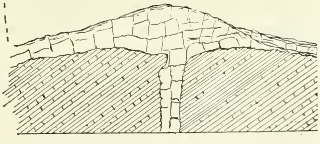


Fig. 3.—Trappean rock breaking through Cambrian shales at Dosthill, near Tamworth.

Standing on the summit of Dosthill the geological structure of the region can be taken in at a glance. The rocks at our feet dip eastward, to rise again in the Hartshill ridge. The coal-field lies like a wedge between two faults, which meet at Spring Coppice, five miles north-east of Dosthill, but which diverge as they extend southward. All the region between these two faults has been uplifted from 1,000 to 6,000 ft. Formerly it was covered, and the coal seams were concealed by a considerable thickness of triassic marls and sandstones; but these have been stripped off the uplifted area by rain and rivers, by frost and ice, and by the sea. But beyond the lines of fault—to the east and to the west, to the north and to the south—the red rocks encircle the coal-field. Beneath these triassic strata, in certain, though not in all directions, the coal-seams now lie at great depths—buried treasures which have been eagerly sought for by capitalists, who, availing themselves of the latest scientific improvements, have bored down more than a thousand feet in search of those "black diamonds" which some ten years ago were in such great demand, and which are absolutely necessary to almost every industry in this country.

TO OUR READERS.

ANY readers of KNOWLEDGE who may have been induced to subscribe either to *The Golden Argosy* or the *Household Journal*, on the faith of prizes offered in the advertisements which appeared in the columns devoted to them here on January 9, February 6, February 13, February 20, February 27, March 6, March 13, &c., &c., *and who have received no prize*, are requested to communicate forthwith with Messrs. BEST & PITTS, solicitors, 57 and 59, Ludgate-hill, London, E.C.

Gossip.

By RICHARD A. PROCTOR.

I AM glad to see our valued correspondent "Hallyards" (with whom however I do not always find myself in agreement — but what does that matter?) raising questions in regard to methods of speaking which are or seem to be incorrect. Although I find grammarians nearly always among the very worst writers of English, and regard the rules of grammar as derived from the study of good writing rather than as having authority in themselves, there can be no doubt that correctness in writing and speaking is a most important matter. Incorrect ways of speaking are apt to obtain currency, if not early shown to be incorrect. On the other hand, however, it should be regarded as a sound rule that where a mode of speaking, though not strictly speaking correct, supplies the only way of expressing some particular meaning, it should be admitted on that account alone. No language is absolutely perfect. For a language is the result of a process akin to the development we find in the vegetable and animal world, and as no variety or species of animal or vegetable life is perfect, so also no language can have in perfection all good qualities.

I FEAR the expression rejected by "Hallyards" as "odious nonsense," must be regarded as a case in point. I do not like the expression "I should have liked to have;" but it expresses a certain meaning which I think cannot be precisely conveyed in any other form of words. In reply to "Sir, Mr. C. called," one may answer, "I wish I had been at home, that I might have seen him," but this expresses rather more than the answer "I should have liked to have seen him,"—as this answer would always be understood. Neither "I should like to have seen him" nor "I should have liked to see him" is quite right. The former really means "I should like *now* to have seen him *then*;" the latter really means "I should have liked—at some past time not indicated—to see him." "I should have been glad had I seen him" implies a more general gladness as the result of seeing the visitor than the form "Hallyards" objects to.

"THAN whom," as "Hallyards" points out, may be correct, but "than who" is never written. Here we have an example of an incorrect expression which has established itself, even as "it is me" had nearly done. Prior has "than her" and "than me" inexcusably, and the other writers named by "Hallyards" have offended in the same way. Yet "than him," "than her," "than me," *may* be quite correct. Thus, "I trusted you more than him" is right, if it means "I trusted you more than I trusted him"; but if the meaning to be conveyed is, "I trusted you more than he trusted you," then of course we should say "I trusted you more than he." In like manner, if some one has said, "he trusted me more than John," meaning "he trusted me more than he did John," and any one doubted who had been named, he would ask "Than whom," but if the statement had been "he trusted me more than John (did)" the corresponding query *ought* to be "than who?"

I CANNOT say I find bad *grammar* in putting a pronoun before its noun. The practice interrupts the reader's thoughts; because either he has to wait till he finds out what or whom the pronoun may belong to, or worse, he starts with the idea that the pronoun certainly belongs to some other noun than that which eventually is found to be referred to. The practice is therefore objectionable. But every one who has occasion to write much knows that it is often very convenient to start with a pronoun in cases where the noun is referred to more than twice, or where other nouns are introduced which might be mistaken for the one we have to find a pronoun for. For instance, suppose we wish to say that "though Henry had taken no interest in Becket's play, he (Henry) somewhat inconsistently," &c.—then, whatever the preceding sentence may have been, or however it may at first suggest that the pronoun refers to Becket, it is convenient and proper to write, "Though he had taken no interest in Becket's play, Henry somewhat inconsistently," &c.; for if the pronoun comes last there is nothing to show whether it belongs to Henry or to Becket.

GREAT-CIRCLE SAILING.

[A *great circle* on a sphere is one whose plane passes through the sphere's centre. A *rhumb course* between two ports or points is one in which the bearing is the same throughout. It is obtained on a Mercator's chart (invented for the purpose) by drawing a straight line from port to port, or from point to point.]

When the late Commander Maury in his "Sailing Directions," and in the celebrated chapter on "Sea-Routes," pointed out the advantage of studying the prevailing winds, in deciding on the course to be followed on a long journey, great-circle sailing had not come into vogue,—though in long journeys the rhumb course had necessarily been abandoned as unsuitable. It was known to seamen that the great-circle course is the shortest distance between any two points on the earth's surface, and in many cases a rough attempt was made to follow this course. The endeavour to find the north-west passage was to some degree a case in point; for on the journey from ports in western Europe to China the shortest (or great-circle) course would carry the voyager into the Arctic regions,—and if the Arctic seas could only be traversed, a course from British ports almost past the pole itself through Behring's Straits to the Chinese Seas would be much shorter than the almost due westerly course which Columbus hoped to traverse. [Note too that the north-east passage, actually achieved by Nordenskjold is theoretically as good a solution of the problem as a north-west passage would have been: and practically too, for both are practically valueless.]

But it was not until the introduction of steam as a motive power that great-circle sailing came much into use. Merrifeild remarks in his recently published treatise on "Navigation," that "as their method of propulsion renders steam-vessels in a great measure independent of winds and currents, their masters can choose their own routes; and as the shortest possible (all other things being [supposed] equal) is the one to be desired, great-circle sailing is coming into greater use than heretofore,

when vessels had to depend on the wind for making a passage." Yet, as a matter of fact, the advantages of great-circle sailing are greater, nay much greater, for sailing vessels than for steamships. Not only does it often happen that the great-circle course would take a ship into more favourable winds—as shown by Maury's charts—than she would find on the rhumb course—but even where no advantage of that sort is gained, and only a saving of distance effected, this saving is of more importance in the case of a sailing-vessel than in that of a steamship,—because it represents a greater saving of time and a yet greater relative diminution of sea risks. And the gain is greatest of all when a ship has to encounter adverse winds. For instance, if a steamship starts from the English Channel for New York on a great-circle course, she may gain about half a day as compared with her time on the Mercator's course. (I am not here considering "the greyhounds of the sea," but steam-vessels belonging to the carrying-trade.) To a sailing-vessel with fair but light winds the saving would be much greater, perhaps as much as a day and a-half or two days. But supposing westerly winds to prevail during the whole voyage, equally on the great-circle and on the Mercator's course, and that a sailing-vessel made 150 miles a day on the tack nearest to her course, then, on the rhumb-line, she would traverse, (thus tacking) a distance of 7,361 miles, and be 49 days on the voyage, whereas on the great-circle course the distance traversed in all her tacks would be 6,488 miles or 873 miles less, while the time occupied by the journey would be but 43⅓ days,—a saving of 4 days and 16 hours. (A sailing-vessel as close to the wind, supposed directly adverse, as she can, may actually on one or other tack be *increasing* her distance from the port for which she is making.)

Reviews.

SOME BOOKS ON OUR TABLE.

Dictionary of National Biography. Edited by Leslie Stephen. Vol. III.: Baker-Beadon. (London: Smith, Elder, & Co. 1885.)—The third volume of Mr. Leslie Stephen's admirable work will suffer nothing in comparison with anything heretofore published with a cognate aim. Once more we find interspersed amongst lives of men whose names are household words the biographies of others whose mark in history has been so faint or obscure as to render it certain that it would be useless to look elsewhere for the story of their lives. The Baliols are here, as are Balfour of Burleigh, Archbishop Bancroft, Sir Joseph Banks, Barclay, Barham ("Ingoldsby"), Barrow, and Bathurst, side by side with Banting, the fat undertaker, and that "Dr. James Barry," Inspector-General of the Army Medical Department, whom many of our middle-aged military readers will remember as a bald little Scotchman, who used to sit on his horse and swear, and who, upon his death twenty years ago, was discovered to be a woman! In the biography of William Balle (p. 79), the authoress speaks as though his claim to have discovered the duplicity of Saturn's ring was first demolished by Mr. Lynn in the *Observatory* for October, 1882. *Suum cuique*, and we have not the slightest wish to detract from Mr. Lynn's undoubted claim to have largely assisted in pricking Dr. Kitchener's bubble; but — merely in regard to the matter of chronology—the reader is requested to consult pp. 294 and 295 of Vol. II. of Knowledge, which, of course, were published some days before the periodical referred to. It is pretty evident, however, from what source Miss Clerke derived her materials. We note one omission in the volume before us, which seems a little surprising, considering the general extremely complete character of the work. We refer to the fact that no mention is made of Sir John Barton, the Comptroller of the Mint early in the present century, whose great mechanical genius and power of invention certainly entitle him to a niche in Mr. Leslie Stephen's Temple of Fame. He was, we believe, the first man who practised the art of ruling lines in excessive proximity,—an art which in our days has culminated in the production of the so-called "Nobert's lines.' Sir John Barton's iridescent buttons, produced in this way, were described by Sir David Brewster and Holtzapffel. He devised, too, an ingenious method of screw-cutting.

Life, the Explanation of It. By W. Sedgwick, Major R.E. (London: W. Thacker & Co. 1885.)—A cursory perusal of this crazy book might impress the reader with the idea that it was a clumsy attempt on the part of its author to poke fun at the doctrine of Evolution. A more deliberate study of it, however, has convinced us that Major Sedgwick is really in earnest in advancing his perfectly wild hypothesis of the genesis of life on our globe. Whence, however, he obtained his science it is hard indeed to conjecture. How any man educated at the Royal Military Academy can gravely maintain the mechanical doctrines set forth in the opening chapters of the work, passes our comprehension altogether. For example, of the persistent action of gravity on a body projected upwards (p. 11) our author seems to have the haziest possible idea. Again: we learn on p. 16 that the earth has a mere crust of solid rock, and is liquid or molten inside. How the precession of the equinoxes happens under these circumstances we are not informed. Furthermore: (p. 18) "Compulsive force" is driving our system towards the constellation Hercules. This ought (according to Sedgwick) to produce a "vast visible source of light" in the direction of that constellation, and the reason why we fail to perceive this is "that our eyes . . . . are unable to appreciate the action of impulses of compulsive force, unless they are retarded to a sufficient extent by repulsive force." (!) Again, the exposition of the determining causes of the earth's orbit, on pp. 28-30, are almost worthy of Zadkiel himself; while on p. 32 it is gravely stated that the moon is attached to the earth, and the planets to the sun, "by columns, more or less conical in form, of gaseous particles." It will surprise no one to hear that the expositor of such astronomy (?) as this persistently misspells the name of Sir John Herschel throughout the volume. The remainder of it we really will not weary the reader by commenting upon. Haeckel's theory is as the utterance almost of inspiration by the side of it.

The Sextant. By Major H. Wilberforce Clarke, Royal (late Bengal) Engineers. (London: W. H. Allen & Co. 1885.)—Written by a man obviously most thoroughly familiar with the instrument he describes, and personally skilled in the method of using it, this tiny book is in every respect excellent, and the very model of what such a work ought to be. Commencing with a description of the sextant itself and the methods of testing it, our author proceeds to explain how to make its various adjustments perfect, to take altitudes both at sea, and on land by the aid of an artificial horizon, subsequently described, and to observe lunar distances. To this succeeds the description of the artificial horizon just

referred to; and then a paragraph on the lamp, and some simple directions for identifying the brighter stars complete the volume. All this is given in the tone and manner of a skilled and genial instructor who, with his pupil by his side, makes him go step by step through the various adjustments of the instrument, and stands by to note and point out any erroneous method of observation. We have detected two or three misprints, which should be corrected in the inevitable second edition. On page 8, line 2, "handsomely" is almost certainly meant for some other word; while on the bottom line of the footnote on page 26, "form" is printed for "sum." The silliest errata, however, appear on pages 28 and 40. On pages 3, 14, 17, &c., we read absolutely correctly 20″, 10″, 35″·5″, 29″·35″, 32″·15·8″, 21″ respectively for 20 seconds of arc, 10 seconds of arc, and so on; but in the two places indicated the dimensions of boxes are given as 16″ long × 10″ wide × 9″ high, and 18″ × 12″ × 1″—which is utterly senseless and meaningless in a book dealing with *angular* measurement. Evidently, if these boxes were placed a mile off, to subtend these angles number one must be 24·57 feet × 15·36 × feet × 13·82 feet, and number two 27·65 feet × 18·43 feet × 1·53 feet! These extremely few obviously typographical errata, though, cannot be held to detract from the value of a volume which should be obtained by every one who may ever have occasion to use a sextant either at home or abroad. When we add that its dimensions are 6 inches long by $4\frac{7}{8}$ inches wide, and $\frac{5}{16}$th inch thick, it will at once be seen that it is as portable as it is good and trustworthy.

Wild Flowers worth Notice. By Mrs. LANKESTER. (London: W. H. Allen & Co. 1885.)—How a certain amount of knowledge, and the power of identification, of the vast number of curious and beautiful plants which stud our woods, fields, and hedges, adds to the charm and pleasure of a country ramble, must be experienced to be appreciated, In the volume before us Mrs. Lankester offers herself as a guide to all who wish to acquire this enviable accomplishment, and by the aid of plainly-worded descriptions and a profusion of coloured illustrations, really does supply a very considerable amount of information indeed. This is a book to be studied before starting on a country jaunt, and carried in the traveller's pocket, that he may recognise flowers on the spot. As far as we have been able to test the work, we have noted only one mistake, and that occurs in Plate II., where the figure of the prickly poppy is lettered "Horn Poppy," and that of the real horn poppy "Prickly Poppy." How such an obvious blunder passed the keen scrutiny of our authoress we cannot conceive.

French-Polishing. By A PRACTICAL MAN. With forty-two illustrations. (London: Wymans & Sons.)—This fresh volume of Wyman's Technical Series is distinguished by the same thoroughness that has characterised its predecessors. Whoever its author may be, he has amply justified his *nom-de-plume*, for his book is practical from beginning to end. Moreover, French-polishing proper, exhaustively as it is treated, occupies a comparatively small portion of the work, which contains, besides, directions for repairing and matching furniture and inlaid work, imitating various woods and marbles, staining, stencilling, ebonising, and varnishing, and is, in fact, crammed with information. No one who is ever engaged in the multifarious operations of which it treats should be without it.

Catch Questions in Arithmetic and Mensuration, and How to Solve Them. By Rev. A. D. CAPEL, M.A. (London: Joseph Hughes. 1885.)—Just now an internecine war is being waged between the examiners appointed by the Civil Service Commissioners on the one hand, and the crammers, who prepare pupils for the various competitive examinations, on the other. The examiners rack their ingenuity to devise catch and trap questions, and the crammers employ all their diligence to circumvent them. Mr. Capel's manual, ostensibly prepared for the use of candidates for matriculation, really renders yeoman's service to the noble army of "coaches" generally. The student who can contrive to master the host of "dodges" and artifices here set forth, may face the arithmetical examiner with the lightest of hearts.

The Young Collector. British Butterflies, Moths, and Beetles. By W. F. KIRBY. (London: W. Swan Sonnenschein & Co. 1885.)—The commendation we bestowed on p. 483 of our last volume on Mr. Kirby's Entomological Text-book may be extended most unhesitatingly and ungrudgingly to the really admirable and absurdly cheap manual whose title heads this notice. In truth, the incipient entomologist will do himself an injustice if he does not procure it. Not the least striking thing in it is the curiously faithful way in which insect markings are reproduced in the mere black and white of ordinary wood-engraving. In fact, as we remarked on a previous occasion, in the case of insects with whose colours the reader is familiar, it is not easy to persuade himself that he is not viewing such colours themselves in the illustrations with which the work abounds. It is a book to be bought by everyone who can get clear of the sound of Bow bells, if it be only for four days in the year.

Successful Advertising; its Secrets Explained. By THOMAS SMITH. Seventh annual issue. (London: 15, Wine Office-court, E.C.)—Mr. Smith's amusing book does what it professes to do: explains how, why, where, and when to advertise with the certainty of ensuring success. It contains a quantity of statistics illustrating its subject, and a list of the various newspapers, journals, and magazines published in London and the provinces, with their circulation, and notices of the various classes among which they do circulate and which they severally specially address. Hence tradesmen, the directors of public companies, publishers, and others, may learn for themselves what medium to select to bring their specialities prominently before those immediately interested in them. Every advertiser may get a "wrinkle" out of this volume.

Magic Squares. New Methods, embracing a General Method. (Dundee: R. S. Barrie. 1885.)—This, in a very compact form, practically covers the whole question of the formation of "magic squares," and may be commended to all who are interested in a very pretty arithmetical recreation.

The Season. July, 1885. (London: the *Season* Office.)—Without discussing whether the present fashion of ladies' dress is becoming or hideous, it may suffice to say that from no periodical can more trustworthy information on its details be obtained than from the one before us.

We have also on our table *Ciel et Terre, The Journal of Botany, The Medical Press and Circular, The American Naturalist, Bradstreet's, The Sanitary News, The Tricyclist, Wheeling, Le Franklin, The Agnostic, The Bazaar, Exchange and Mart, Electricité, Medico-Legal Journal, South Australian Register, The Househunter,* and that Arabic scientific journal, of which we can neither decipher the title, contents, nor place of publication.

THE number of visitors to the Inventions Exhibition last week was 150,053. Total since the opening, 1,572,618.

CHATS ON GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

THE SPHERE.

(Continued from page 25.)

II. Volume.

A. And now we are to attack great Archimedean problem,—to compare the volume of the sphere and cylinder!

M. We have to all intents and purposes solved it already, in determining the area of the sphere.

A. That is strange!

M. It is as certain as that the quadrature of the circle is accomplished so soon as we have determined the circle's circumference.

A. I think I see your drift. We divide the circle into an indefinitely large number of sectors which in the limit may be regarded as triangles; and I suppose you divide the sphere into an indefinitely large number of spherical sectors (I know not what would be the name for them) which in the limit may be regarded as pyramids.

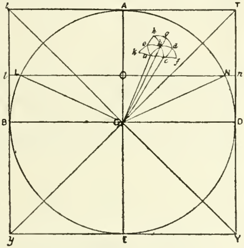


Fig. 3.

M. That is the way. Suppose a b c a very small spherical triangle, on the surface of the sphere A B E D, Fig. 3, whose centre is at C, and join C a, C b, C c. Then it is evident that if the sides of the triangle $a\,b\,c$ are small enough, the difference between the solid sector C $a\,b\,c$, and the pyramid C $a\,b\,c$, on the triangular base $a\,b\,c$ is evanescent compared with the volume of either the solid sector or of the pyramid, and may therefore be neglected. By taking other points d, e, f, g, h, &c. and making the triangles $b\,d\,c$, $d\,g\,c$, and so on, we can cover the whole surface of the sphere with small spherical triangles, the solid sectors corresponding to which make up the total volume of the pyramid. Now manifestly the sum of the surfaces of the plane triangles $a\,b\,c$, $b\,d\,c$, &c., is equal ultimately to the area of the sphere. Hence, Volume of sphere

= sum of volumes of the pyramids C $a\,b\,c$, C $b\,d\,c$, &c.

= pyramid having sum of areas $a\,b\,c$, $b\,d\,c$, &c., for base, and radius of sphere for height.

= pyramid having surface of sphere for base, and radius of sphere for height.

= $\frac{1}{3}$ rectangular parallelopiped having a base equal to the area of the sphere, and a height equal to the sphere's radius.

= $\frac{4}{3}$ rectangular parallelopiped having a base equal to a great circle of the sphere, and a height equal to radius of that circle.

= $\frac{2}{3}$ cylinder as t T Y y having base equal to great circle and height equal to the diameter of sphere.

= $\frac{2}{3}$ of a cylinder enclosing the sphere.

A. That is certainly not a very difficult solution. It is singular, by the bye, that the volume of the sphere bears the same relation to the volume of the enclosing cylinder, that the surface of the sphere bears to the complete surface of that cylinder.

M. Yes, putting the radius of the sphere equal to r we have

(1) Surface of sphere $=4\pi r^2$
(2) Surface of cylinder $=6\pi r^2$
(3) Volume of sphere $=\frac{4}{3}\pi r^3$
(4) Volume of cylinder $=2\pi r^3$

Note also that if we have a cone with y Y one of the circular ends of the enclosing cylinder t T Y y as base, and A as vertex, then,—

vol. of enclosed cone : vol. of enclosed sphere : vol. of enclosing cylinder
:: 1 : 2 : 3

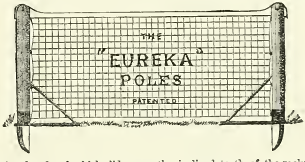
(To be continued.)

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (Knowledge *being a popular magazine*) *than is accorded by the most excellent trade journals.*

LAWN-TENNIS POLES.

[Patent No. 10,776. 1884.]—This patent, taken out by Mr. R. Pearce Brown, Thorganby Hall, York, claims simplicity, neatness, and facility for fixing. Briefly described, it is a combination of lawn-tennis poles jointed to plugs driven into the ground, and capable of motion in the plane of the net, of toothed racks lying on the ground and stays jointed to the poles, the lower chisel-

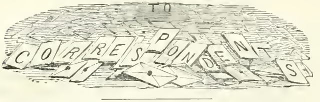


pointed ends of which slide over the inclined teeth of the racks, and abut against the vertical sides of the said teeth of the racks, thus preventing the return motion of the poles. Thus, when it is wished to tighten the net, it is only necessary to separate the poles to the distance giving the required tightness to the net, when the poles are automatically fixed in the positions to which they have been brought, and the net is maintained at the required degree of tension. The makers are Messrs. Chas. Malings & Co., 18, Cockspur-street, W.C.

STEREOSCOPIC PICTURES.

Mr. W. E. Crowther, late of the Manchester Technical School, has devised a scientific arrangement for the production of stereoscopic effects in pictures thrown upon the screen by the lantern. The method is as follows: two lanterns are used, each of which projects one of the two corresponding stereoscopic transparencies upon the screen, so that both fall together upon the same field. The light from the lanterns, however, is not white, but of any two complementary colours, as red and bluish green. The spectators wear non-magnifying spectacles fitted with glasses of the same tints as those used in the lantern, and the result is that each individual sees one picture only with each eye, viz., the picture thrown from the green lantern is alone seen by the eye wearing the green glass, whilst the eye shielded by red glass sees the picture thrown from the red lantern. In this way each eye is affected only by its appropriate stereoscopic view, whilst the mind receiving simultaneously the two views in complementary colours combines them into a light and shade representation which possesses some peculiar properties of lustre.

The combined picture, as viewed by the naked eye, is for the most part white from the union of the red and green lights upon the screen. The stereoscopic differences of the pictures or overlapping portions only are chromatic. By slowly turning the lanterns so as to shift the screen-pictures slightly to the wrong side of each other, so that the optic axes of the spectator may intersect in front of the screen, the picture appears to advance and become suspended in the air before the screen.



"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office,* 74, *Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

NATURAL SELECTION DEBATED.

[1826]—Might I take the liberty of asking Dr. Hutchinson to scrutinise the behaviour of his termites again. On Saturday, July 4, about an hour before sunset, I had an impromptu proof that *our* ants, at all events, *do* take unto themselves wings to fly away for the connubial operation—a much ado about nothing, I can assure ye!

Reposing in the paradisaical Italian evening behind trellissed vine, before mountain bluff, the swallows making the air *allegrissima* overhead, my attention was all at once called to a formiculating black patch on a low stone wall (once more taken possession of by Instinct, as though it had been Reason). It proved to be a colony of big black ants, very different from the red-headed, cock-tail little ones indoors, a few feet off. Lustrous jet black, pearly-winged queen-ants a lot of them seemed to be. Then there were two other sizes smaller. They deigned no notice of meat, bread, and sugar I brought them. Lo! right above my devoted head a column-like swarm in full swing. Such a sight! The small, almost tiny, males, innumerable (why so much more numerous?—*per* "Nat. Sel."?) making me think of a chaos of Saturn's "rings" and, the while, renewing my marvel that astronomers—thoughtful, earnest men—so long blundered, except Cassini, with his flash of genius, about Saturn's "rings":—the first child whirling round a burnt stick might have taught them the truth!—the old Copernican truth—*apparence*. The ephemeral creatures seemed mad (fancy their tiny brains!) with excitement and pre-occupation. A stick, a hand, a handkerchief dashed through them made no difference. The females were few, and so much bigger than the microcosms of passion—the males—as to make these latter look ludicrous. Their union did not take place in the air, but after they had come down "flop" on to me, and the pillow I put. Then I noted, 'twas not the same species as the black patch before me—several of whose "queens" were slyly snapped up by a lizard time after time, who then retreated into *his* hole to enjoy the repast, by no means killing the protesting, wriggling victim straight off. Happily, I doubt, the lower animals do not feel much.

The female ant in the air, as on the ground, seemed indifferent, in the charming feminine way. The myriad males went madly gyrating about her and above her, and then, at last, one or two literally knocked her down (*piombavano a terra*). There was another swarm close by, and another and another in my walk further on. *Ecco*, evidently a use of *these* wings, though why they should fly into the air to be knocked down to the nuptial couch, I am not clear. No birds of the air swooped on to my ants. This factor, of course, seems to make a difference. In fine, ants gradually—O, so gradually—"acquired" their faerie pinions (two pairs) *per* Natural Selection, *id est*, through inherited, cumulating, victor-variations, the happy individuals that "happened" to develop the first rudiments of wings, getting the best of it, and gradually exterminating or extinguishing their competitors—all this, I reiterate, doth unto me for one indubitably, *pro tem*, make Darwinism dubious.

And here I may assure your courteous correspondent "Gamma," who finds *the* pleasure of thinking for himself, that our lamented illuminato, I may say staked his reputation on this, the doctrine of Natural Selection; although he, with his Shakesperian temperament and genius, is never to be confounded with those arrogant Positivists of his disciples who out-Herod Herod; whereof the irrepressible Haeckel, perhaps, is head and front offending—he who was so promptly and properly put down by Du Bois Raymond for claiming the irrepressible Goethe as a great poet, but far from giving us "measureless content"—his academic Faust will not compare with the flesh-and-blood Hamlet as an anticipator of Darwin. Haeckel, *der junge freund* of the Master, who did not quite speak as became him of the Master, but rather as though he were the great Darwin, not in the tone that became him—it is the tone which is so objectionable in these extremists; it was, *e.g.*, in Wagner—especially of the Master's knowledge of German (of course!) But to resume. If "Gamma" will turn to *our* "New Testament" he will at once see that "Natural Selection" *is* Darwin. He expressly cites the eye as being the result of Natural Selection—likewise the whale's mouth (subtly-furnished cavern!); and other divinely complicated cases. He evolves all from one, *viâ* Natural Selection; that is Darwinism.

Now, though we do *seem* to see one protoplasm, even now the origin of animal life and form (not seeds?) yet mark, it is individual, *respective* protoplasm, *already within a fully-evolved life and form—the Mother.* Thus upon the threshold *sul stellato soglio* we are in doubt as to Evolution itself; grand propriety though it seem to be, truly scientific, like Nature's way—that it is "the result of Natural Selection" we may be pardoned for continuing to hold to be "debated and debatable." It took five hundred years for Christianity to establish itself; Darwin himself would be the last to complain of our threshing away at his *ism.* His grand merit was to electrify thought. Darwin himself "discovered" the Niata cattle and Ancon sheep, &c., striking cases of variation by leap and bound, such as "Gamma" has in his mind's eye; and I still feel that the Teacher himself scarcely felt the full force of that; of Monstrosities, and—Metamorphosis. Look at the case of the Medusa; the zoea and nauplius stages; the chrysalis and butterfly—more beautiful than poet's dream! Will Darwin say that these magical, miraculous transformations (at the side-scenes) were "acquired"? How can we imagine the simple hard chrysalis acquiring the power to evolve into the magnificent butterfly, by useless rudimentary steps, which gave it the advantage in the struggle for existence. But, if these things transpired by LAW—the Unsearchable, Ubiquitous, Self-Existent, Imminent God—then they seem more conceivable, or, at least, receivable; just as the Inorganic World is; gravitation-soul'd star-rich space.

With regard to Shakespeare, too. Curious! Just as "Gamma" was penning his letter I was thinking of writing to you to inquire, Can Natural Selection account for Shakespeare? Yet a little while and his ancestors were besmear'd barbarians of the Stone Age, confronting Cæsar (marvellous destiny! little England with her honours thrust upon her!) Like Burns, he sprang from the toiling-moiling million. Neither by Class nor Circumstance, it would seem, had his seraphic brain had the way prepared before it. What Evolution, what Natural Selection, ages of practice and conquest, turned out that? But Shakespeare *may* have had Cæsar's own blood in his veins, or Plato's. He must not forget, too, that his Age, the men of it, were a magnificently potent (not impotent) race, of which, over there in Cæsar's Italia, the world-man Columbus was the true Coryphæus—and the world-man Galileo; and the world-man of science, the Columbus of Urania's America, the Proto-Martyr of Science, Giordano Bruno.

Beethoven, too (the only peer with Shakespeare), came after those Columns of Hercules, Bach and Handel, in a musical age like a great tree in flower. The profounder inquiry remains, what made the race take such a giant-stride and saltation of genius? Nay, specially, what made this Nineteenth Century do so? Ages of cunning and brutality, of lust and drunkenness, by wretches who knew not how many beans made five, scarcely at first sight seem to explain Shakespeare and Beethoven *per* Natural Selection; scarcely seem to explain their immense *pure* brains. Yet it may be so; at least, in part. The spectacle of these centuries we now perceive to be the Star of the Teutonic Race in the ascendant. But their civilisation, that has indeed advanced by leaps and bounds, towered by Titanic impulses. With regard to music, I think Darwin's doctrine immensely suggestive; more subtle and profound than Spencer's—viz., that man's music is the outcome of ages of animal evolution; that we are *so* moved by music because, unconsciously, we thrill with the recollection and experience of æons of animal ancestry or pre-existence; wherein, from the nightingale up to the eagle, lion, and gibbon, we employed the Voice in the most intense period of our life-history, during passion, when the female was the centre of all existence; and male warred against male, to monopolise her, with the fiercest drunken joy; thereby also helping on his own evolution, and (according to Darwin's beautiful, if unproven, speculation) Beauty—Beauty the nearest form of God!—Music seems to me infinitely *more* than this: Prophecy *rather* than Past; as it were, the

besouled flesh and proof of Immortality; still, the idea of the Prophet of this generation (what went ye out for to see? A man blameless and beautiful as the lily, illumined as the starry heavens) is, in its way, grand.

Perhaps I may be thought inconsistent, but in these tentative contributions I am labouring, rather feeling my way, to the part as it were of judge, if possible, if I may say so, not Advocate for or against: though I confess that the Theory of Natural Selection, as the cause of evolution, seems suspicious to me; likewise, indeed, the theory of Evolution (from one) itself, in spite of the vastness of the plausibility of its generalisation. For example, the very *sine quâ non* of his theory is;—*if* a victor-variation happens to show itself:—but, now, it occurs to afterthought that this very *if* may not take place, not be the *modus operandi* and scheme of things; but, on the contrary, that, like the "Solar System," (even in its inconceivable flight towards Hercules) *all may swing together*: that no perturbation can occur in the subsolar system without compensation; that the Imminent Cause, from everlasting to everlasting, *in* all, may take order for it (I do not here say consciously); that *pari passu* shall be the order of the day, of the tremendous slow march, that one of its dearest words shall be and abide, as before quoted, that from the lips of *the* Chrysostom, *the* Poet, greatest Humility and greatest Heroism, "Not a sparrow falleth to the ground but what your Heavenly Father knoweth it!" ALEXANDER TEETGEN ("Commentator").

NOTE ON INDIAN TERMITES.

[1827]—In my paper on Indian termites, I alluded to the indomitable energy and perseverance with which white ants annexed the bell-beam in the church tower, or the beams of the house built over their nest. Recently I witnessed this energy in another direction. An ant-hill had been levelled to make way for a long line of road-ballast; this, made up of laterite fragments, ran parallel to the road, and its width and height were four feet and eighteen inches respectively. Offended at having been thus slighted, the termites, in *one* night, rebuilt their hill, *running it through the densely-packed laterite*, and raising it eighteen inches, with a base of thirty-six inches.

Now, think for a moment what this implies. These mites, determined upon not being sat upon, and scorning the mountain suddenly imposed upon them, *determined on boring and building through it*; and this they did. Consider the enormous labour implied in each termite wriggling through the rough angular masses of laterite, each laden with its pellet of mud; and not only is the mud to be carried for the heap on top of the ballast, but also for the sides of the tortuous passages through the closely-piled laterite. Except for their aspirate excelsior craving, these indefatigable workers could have pushed their works on each side of the ballast-heap; but their doing so would be contrary to their principles, and imply defeat. R. F. HUTCHINSON, M.D.

Pachmari, June 21, 1885.

VITAL FORCE.

[1828]—If it were not so sad in its consequences, it would be amusing to note how disbelief, in order that it may put on a certain seeming of respectability, clings to tenets only to be reconciled with belief. "F. W. H." appears to be incapable of discerning that the doctrine of necessity totally excludes the conception of right and wrong, for whatever should happen by necessity could happen in no other way. Theft, murder, &c., would all be in the unalterable course of things. We owe the distinctions of right and wrong to a belief in a Supreme Being, that determines what men ought and ought not to do. Without such ruling a man could by no possibility do wrong. If he committed murder, suicide, or anything which we now call criminal, by necessity he would do it by nature's compulsion, in the natural course of things, and be blameless.* Hence my piteous appeal, as "F. W. H." is pleased to call it. Your correspondent says, "knowledge supersedes belief;" that is quite true, but, unfortunately, your scientific pundits too often forget that that knowledge which they deem so very absolute and positive, is only the outcome of a *belief*—of a belief in the existence of an external world, of matter, &c. This belief in a material universe is as much a belief as that in the existence of a Supreme potentiality. There is, in fact, no *positive* knowledge but that of our own existence and of the mathematics. Sir John Herschel aptly termed the mathematics, "the very soul of science." How any one who has adopted the teaching of the Doctrine of Necessity can be so illogical as to talk of transgressing the laws of nature is truly surprising; there can be no transgression under necessity. It will come to be seen that from the standpoint of my letter (1759) on Vital Force that the evidences of a Ruling Power are as strong as the evidences of a material universe. Berkeley and Lewes have been frequently referred to in your correspondence columns, but the writers in every case appear to me to have missed the point of their teaching with respect to "Idealism," which was that the existence of matter could no more be demonstrated than the existence of a Ruling Spirit. In both cases you have to rest on belief; and, if nothing else should move men to cling to the doctrine of a Ruling Power, the very utility of such a belief should. METER.

[* See Professor Clifford's Essays on "The Ethics of Belief" and "The Ethics of Religion," in the collected edition of his "Lectures and Essays."—ED.]

INSIDE OR OUT?

[1829]—"J. S." (1801) is mistaken in supposing that my views are in any way modified. I would point out that the words "external" and "independent" are not synonymous. The former involves the assumption that the relation of the world to the mind bears an analogy to the relation between two bodies in space; the latter simply implies that the world continues to exist when we cease to be conscious of its existence, and that it did so exist during the untold ages when sentient life was not. It is clear, however, that this cannot be true of the phenomenal world which we know, and with which alone we are concerned; since this is composed of our own sensations and thoughts. When I said that "every valid concept must certainly be correspondent with a thing," I used the word "thing" in the sense of "object"—*i.e.*, a synthesis of sensations. This, of course, cannot properly be said to "represent" anything, since a sensation is the simplest element of consciousness. An object is not a re-presentation, but a direct presentation. That a concept may be "non-valid" is clearly proved by the concept of idealism in the mind of "J. S." It is especially funny that he should commend to my notice a passage from G. H. Lewes, which is not even Hylo-idealism, but pure Berkeleyism. C. N.

[Following the argument of "C. N." to its logical conclusion, it would seem that the sole difference between the audible suggestion of the Demon of a gentleman in Hanwell, and a speech of Mr. Gladstone is, that the one "is composed of the sensations and thoughts" of an individual in confinement, and the other of those of a reporter at large.—ED.]

GASES AND GRAVITY.

[1830]—In letter 1,805, What does "Hallyards" mean? Take the case of a jar full of carbonic acid and hydrogen; both gases are resting on the ground. Why is this an exception to the universality of gravitation? "Hallyards" says that "carbonic acid gas should always be the lowest." This seems equivalent to saying that in a room full of people those of sixteen stone "should" be on the floor with the lighter people sitting on them! F. G. S.

[Not quite! Shake oil and water together in a bottle for half-an-hour, and then set the bottle "on the ground," and you will find that the oil will at once separate from the water and float on the top of it.—ED.]

THE GENESIS OF THE MOON.

[1831]—If there is "nothing impossible" in the "extravagant paradox" cited by "Hallyards" (see letter 1779) concerning the pre-lunar origin of the Arcadians, and the extraneous origin of the moon, it is at least a paradox at variance with the few facts we possess concerning the moon's early history, and the many reasonable deductions which have been inferred from geology and the consideration of the tides.

That the tides are older than the possible age of man is scarcely open to doubt. Rivers, storms, glaciers, &c., are all inadequate to account for the varied phenomena of geological formations. The tides are a requisite agent, and not merely tides such as we now see, but tides of much greater magnitude and power. In necessary sequence it is generally held that the tides are gradually subsiding, a fact only to be explained by the supposition that the moon is ever widening its orbit, and that in earlier times it was in much closer

proximity to the earth, a supposition which gives us the "chip of the old block" theory. If the moon's advent in our system were as recent an occurrence as "Hallyards" considers possible, the geological formations would give unmistakable record of the fact, and even sufficient evidence to form an approximate date. The solar tides are of comparatively little importance, and could never be confounded with the lunar tides.

With reference to the colour of air, I cannot conceive a reason why aqueous vapour should lose colour by being condensed, or why the particular formation of the particles of water in aqueous vapour should "show the colour."

By admitting "Hallyards'" statement, that "A Scotch or Irish landscape looks much bluer than a French one," his idea (that the colour of the air is due to the water it contains) would lose its chief support, for the warmer the climate the more water will its atmosphere hold in suspension, which would give us the *maximum* of colour to the *minimum* of water, and *vice versâ*. It is only fair to add, however, that this is not the case; as we proceed south the colour of the sky is intensified, and consequently the colour of the landscape.

It was the fine blue of eastern skies which gave birth to the "Waters above the earth" theory.

That the air of Mars may be all oxygen, and therefore more life-supporting than our own, is impossible.

In the first place, life is maintained by the utilisation of that property of oxygen, of readily combining with other elements to its own contamination; and, secondly, an atmosphere of pure oxygen could never exist in the presence of many other elements essential to life; chemical action would ensue and destroy it.

The particular composition of our atmosphere must not be considered as the work of haphazard chance, but rather as the result of circumstances and causes which in all probability would be also active in the planet Mars. "Hallyards" has entirely misunderstood me in supposing I complained of his "*may be's*"; he is at liberty to draw an inference if he can give sufficient reason for doing so; it was the *because* I could not allow, the reason he gave why oxygen might be red, was directly opposed to a fundamental rule of chemistry, which makes the properties of a chemical compound independent of the properties of its elements, whereas, "Hallyards" seems to ignore the existence of such a force as affinity, and argues as though the properties of a compound were the *sum total* of its ingredients: and the same mistake also occurs in the following:—"oxygen may well be blue, since water contains nine-tenths oxygen." From a chemical standpoint, oxygen and nitrogen *cannot* be "frozen" or vapourised (hydrogen was never mentioned); but, taken in a broader sense, "Hallyards" is no doubt correct in assuming that all matter may be either gaseous, liquid, or solid. ALEX. MACKIE.

THE DIRECTION OF LIGHTNING.

[1832]—Several years ago, late in summer, and in the dusk of evening, I was on an open vehicle on a very exposed road, when a hailstorm came on, to protect myself from which I put up my umbrella, and as the wind was at my back some of its ribs necessarily pointed upwards, whereupon they immediately became tipped with the most beautiful pencils (*not stars*, mind you) of electric light I ever saw, affording thereby conclusive proof of the *direction* of the current. Which being so, it now rests with those who deny that lightning ever strikes *upwards* to show, if they can, how it happens that what is possible under a *weak* electrical tension is "impossible" under a *strong* one.—Yours faithfully,

WM. ALLMAN.

N.B.—In the great thunderstorm of June, 1846, which heralded the potato failure in Ireland, the direction of the flashes of lightning was, mostly, neither up nor down, but horizontal.

[The phenomenon witnessed by Mr. Allman was the ordinary "brush discharge," familiar to all users of a frictional electrical machine. What I understood the Conductor of KNOWLEDGE to deny was, not that lightning strikes upwards, but that *it is impossible for the observer to see this*.—ED.]

GEORGE ELIOT.

[1833]—This journal is specially interesting to me as being (I think) of a unique type, "conducted" by one, "edited" by another. "So far as we can make out" (said the *Saturday*, in 1874) "Lord Hartington is to act the part of a highly-respectable man, content to be outshone whenever it pleases Mr. Gladstone to throw the full solar splendour of his mind on any subject." You, Mr. Editor, inserted the views of "Commentator" on the late Mrs. Cross, and shortly after, on the same subject, gave us a note of your own condemning public approval of concubinage. Now, these pronouncements—"C.'s" explicitly, your own implicitly—have given "intense pain" to our eminent conductor. "Something rotten in the state of Denmark"—or, let us take Japan. The Mikado resumes the reins of power, displacing the Shôgun.

Trêve de plaisanterie. I thought faith and morals* were to be kept out of *K.*; but, since it is not so, I implore Mr. Proctor to state *explicitly* whether he really teaches that it is right and *laudable* for any individual to dispense, for his own convenience, with any particular precept, civil or religious, which may chance to hamper him for the moment.

If so, then there is no more law of any kind for anybody. As thus, The sole standard of conduct for individuals has always been the rule settled by the society of which they form part. It is erroneous to suppose that Christianity is the basis of our European code. Horace derived stricter principles from his father than any young Italian of our day from his. I doubt whether any man ever was put to death for unchastity; but vestals were, when Rome had as much dominion over Italy as we now have over the Soudan. No Christian child is ever guarded so strictly as were the young Pagans—"Odisti claves, et grata sigilla pudico." Yet this very same people gave a father the option of destroying his new-born child! In Lydia, the "whole duty of woman" when young, consisted in earning her dowry by prostitution. In Assyria, every woman was obliged, as a religious duty, to submit to prostitution once in her life—(cunning fellows, those priests of Myrtilla—Herodotus says no amount of money would induce an Assyrian woman to sell herself afterwards)—Now, were these acts sinful? No, says the Catholic Church; they violate no natural law, and so "heathens, and ignorant Christians, may live as the beasts without being in sin." I have no doubt, that, for this reason Polynesian girls are as fair morally as they are physically. But as regards *Europeans*, the uniform result of my experience is that a woman who disregards the standard of her society is *morally hideous*, and falls behind *in every respect*. The hetæræ of Athens were not degraded by cruelty, rapacity, theft, and drink as are ours.

Renan remarks that *very few* have the right to reject Christianity. I do not believe Miss Evans was one of these few, for the simple reason of her sex. Women admit *themselves* they do not reason, but *feel*. Moreover, a woman who decides that all religious belief is false commits an act of extreme arrogance which does not prepossess. The pictures of George Eliot and Mr. Lewes are, both of them, perfectly repulsive to me.

In 1858 (and later) it was the custom at Brighton (and elsewhere in England) for men to bathe from machines perfectly naked. In 1868, any man so doing would have been not only fined, *but thought immoral*. So true is it that public opinion for the time being is the only law we may not violate.

The sanction accorded by society to George Eliot is merely another instance of the idolatry of *success*, which makes one blush for one's species. Without, it Lord Tennyson would not have taken Miss Evans as a housemaid. With it, he adorned her drawing-room. But why stop at her? Go on to George Sand. *Her* liaisons were legion. Why should she be fettered?

I conclude by a few comments on some of Mr. Proctor's words (which I run no risk of imagining, since I have them before me):—

"Of the relations between G. E. and G. L. it becomes none to judge, unless it can be shown that any one was personally wronged in the matter." How about the popular phrase "the injured wife?" And, without that, are there no acts which do no harm to any one, but which society justly abhors and persecutes? "Even then, judgment by an outsider would be improper." Nay: Mr. Proctor forced us to judge, by giving us *ex cathedrâ* Miss E.'s views on Immortality—of which she could know no more than any one of us. "To all intents and purposes, save as regards the letter of the law, G. E. was G. L.'s wife." I imagine Mr. Proctor *minus* his purse, and the taker saying the above, *mutatis mutandis*. Then *I* would say "*Quis tulerit Gracchos?*"

"Had the legal ceremony been performed." The Catholic church teaches that "in the sacrament of matrimony, the minister is the sponses themselves." The essence is the consent of the parties, *if free*. But one of the parties here was not free. "They were united by a tie which was to them perfectly sacred." So is the burglar to his spoil.

Mr. Proctor has apparently every reason to be content with the institution of matrimony, I am in exactly the contrary position; yet I have never desired to be free, or contemplated a "privately-sacred" arrangement, believing that it is for the benefit of society on the whole that marriage should be dissoluble only by death.

Mr. Proctor's doctrine seems to be that anyone may give himself a private dispensation from the settled rule. How much more

* Questions of faith, as pertaining to theology pure and simple, are, and must be, rigidly kept out of these columns; but ethics admit of treatment at once from a psychological and a sociological point of view, and hence are perfectly in place in a journal devoted to science.—ED.

rational is the Catholic theology; which, while labelling innumerable acts as mortal sins, yet admits that inadvertence, or vehement passion, may render them *in particular cases* only venial. Thus the perfection of the code is maintained, while it is left to God alone to say whether in any given case there is guilt. The sin is detestable, but the sinner may not be detested, because he cannot tell, even himself, whether he is sinning, or merely yielding to human infirmity. HALLYARDS.

OUR BOYS AT SCHOOL.

[1834]—If you will permit me, I will make a few remarks on the subject of "Our Boys at School."

Three-quarters of a century ago Sydney Smith wrote an article very similar in its condemnation of public schools to the article in KNOWLEDGE last week, so the subject is not a new one. It is of course a truism to say that the moral tone of a school depends to a great extent on the masters and headmaster, but unless we are to take it for granted that the tendency of English schoolboys is to bully and become Tasmanian devils, the influence of public opinion in a large school must be greater than the influence of an usher in a small school, however close and prying his supervision may be. To say there is a savage idea underlying the working part of our public school system is certainly an exaggeration, if not a distinctly mistaken view of the system altogether. Bullying may be encouraged in certain public schools, it certainly was not at Rugby, but to say that it is encouraged by the system of monitors shows a complete misunderstanding of the system.

Sydney Smith says, "at a public school every boy is alternately tyrant and slave." From the article in KNOWLEDGE a reader would imagine that a boy passed immediately from being a fag to being a monitor. Such, at any rate, was not the case at Rugby. At least one-third of the school was called the Upper School. As a rule boys took a couple of years to pass through the Upper School, and, while in it, were neither fags, nor could they exercise the powers of monitors. On the whole, they represented the best physically, intellectually, and morally. They held the balance of power between the Sixth and the Middle Lower Schools. If the Sixth had unduly exercised their power, a house levée or a school levée would have been called, and the Upper School would have taken the side of right against might. If a combination of fags had unreasonably refused to obey certain orders of the Sixth, the Upper School would again have decided the matter equitably.

To the boy of average capabilities, physically, intellectually, and morally, there is not the slightest doubt the public school system is the best system of training. For the exceedingly precocious, or for the extremely weak physically, intellectually, or morally, it may not be the best, but if it is not they are exceptional cases, and require therefore exceptional treatment.

First, the physical advantages. In a large public school each boy can find some game suited to his strength. He has a choice of cricket, racquets, fives, rowing in some, gymnastics, or volunteering, and in winter football and paper-chases. In a smaller establishment a boy is confined to cricket or lawn-tennis, or walks with Mr. Barlow, after the manner of Tommy and Harry in "Sandford and Merton." Should a boy be fond of bird-nesting or geologising, he will find just as much opportunity in one as the other of indulging in his pet virtue or vice, as people may consider it. What public schools are referred to where there is daily kicking or weltering with a stump on cricket afternoons, it is difficult to guess. The present writer has travelled and resided in nearly every part of her Majesty's dominions except Canada, and has met men in them from every public school worthy of the name, but, so far as he knows, he has never yet met the schoolfellows of that statesman who *possibly* owes his greatness to being daily kicked at school. He (the writer) was about four years at Rugby, some twenty years ago, and the only cases of bullying he ever heard of were in spite of the public school system, and occurred in the Lower and Middle Schools, the bigger boys in a form bullying the smaller ones; but they were isolated cases, and soon put a stop to by the form-master. What with a matron to every fifty boys, and doctors' certificates, and masters joining in the games, surely the danger of anything brutal occurring is reduced to a minimum. But is King's College School, where the recent case of bullying occurred, conducted on the public school system?

Secondly, intellectual advantages. When the writer was at school, Latin verses and Greek classics were considered a necessary part of the public school curriculum. Such is not the case now. But it is very doubtful whether what a boy learns is really of as much importance as how he learns it. Until a boy is sixteen or seventeen he does very little more than learn how to learn. The writer, who has had some little experience in teaching boys, but not English boys, is of opinion that up to a certain age making a boy use a gradus or a dictionary properly is as good a training for the intellect as botanising or showing him experiments in chemistry, electricity, and the like. In a large class it is certainly a more convenient mode of educating. To suppose that one system or another would produce more Tennysons, more Huxleys, or more than our one general, is to misunderstand the subject of school education generally, and public school education more particularly. The majority of boys attain such a low standard of knowledge in any and every subject, that in practical life it makes very little difference to a man what he has learnt at school. At any rate, the great majority of boys learn at a public school how to learn sufficient of the particular subject which they are learning to prevent themselves being punished. In a private school, where more attention was bestowed on them out of school, they might not even learn this, though they might get through more book-work. But private tuition can always be obtained, if desired, in a public school.

Thirdly. The moral advantages. It is the experience of the writer and everyone he has consulted on the subject, that the standard of morality in public schools is higher than it is in private schools, but, of course, much depends on the masters. Considering the manner in which headmasters and masters of public schools are appointed, and the opportunities the public have of criticising their conduct, they must, as a rule, be the best men available. A boy should be therefore more likely to learn at a public school than anywhere else that purity is more manly than impurity, that honesty is the best policy, that lies and deceit are the weapons of sneaks and cowards, and that those that speak the truth always are brave men. JOS. W. ALEXANDER.

MYSTERIES AND MORALITIES.

[1835]—Anent "Mysteries and Moralities," so ably explained in KNOWLEDGE by Mr. Clodd, there is an older and, to my mind, better explanation why the "pagan" festivals coincide with the "Christian" ones, viz., the theory that they spring from the same source, or the root of most existing religions, *i.e.*, solar worship. "Many," says Tertullian, "suppose, with greater probability, that the sun is our God, and they refer us to the religion of the Persians."—"Apologet," c. 16. Certain it is that all the "Christian" festivals correspond with the equinoxes, and summer and winter solstices. The "sun worshippers" of Mexico and Peru held dogmas almost identical with Christianity, viz., immaculate conception, crucifixion, resurrection, and redemption. F. W. H.

BIBLIA PAUPERUM.

[1836]—In reply to Mr. Webb's inquiry, the following is the full title of the work referred to in my paper on Mystery Plays:—"A Smaller Biblia Pauperum, conteynynge Thyrtie and Eyghte Wodecuttes Illvstratynge the Lyfe, Parablis, and Miraclis off Oure Blessid Lorde and Savioure Jhesus Crist, with the Propre Descrypcious theroff extracted frō the Originall Texte off JOHN WICLIF, somtyme Rector of Lutterworth. With Preface by the late Verie Rev. ARTHUR PENRHYN STANLEY, D.D., Dean of Westminster." Square 8vo. Bound in Parchment, old style; brass clasps; price 10s. 6d. Published by Mr. Fisher Unwin, Paternoster-square.

I have, however, not had the opportunity of comparing this with the *Biblia Pauperum* preserved amongst other early specimens of block-books in the British Museum, and of which a facsimile was published in 1859, but I have an impression that the "wodecuttes" are replicas of blocks from an old German book of the sixteenth century. EDWARD CLODD.

"HOW TO GET STRONG."

[1837]—I think Mr. Proctor's rules for strengthening the limbs will be disappointingly like the French plum-pudding, which failed because the receipt had omitted all mention of the pudding-cloth. It is a principle that "involuntary motion does not tire;" hence our hearts go on beating all our lives without crying for a rest. A gun is lighter than a cane, if we have hope of sport. A walk without a friend or an object is a saddening affair. In a gymnasium I used to wield clubs and dumb-bells, and got strength thereby, because there were comrades and admirers. Had I been alone, I should have been tired in a few minutes; and I suspect my muscles would have "sucked thereout but small advantage." I can conceive few things more lugubrious and ridiculous than, say, an elderly gentleman, with *K.* on a music-stand beside him, solemnly moving his arms up and down *secundum artem.* A lathe or a joiner's table would give him far more strength. So it would to send off

the servants, and do all the work for himself. I have tried that, and it is capital fun. In a short time it gets as natural as shaving, or soldiering. HALLYARDS.

FORGOTTEN GEORGIAN PHRASES.

[1838]—"When George Primrose's cousin says to him: 'May I die by an anodyne necklace; but I had rather be an under-turnkey in Newgate,' who is there in the present year of grace who knows what he means? It appears that it was a notorious quack charm against the perils of teething, and that mothers never forgave themselves if their children died of convulsions without having tried an anodyne necklace. We may point out that the editor's ingenious note, in which he quotes an advertisement in which it is said to be sold for 5s., 'as patronised by the King for the Royal children,' does not quite exhaust the question, for what George's cousin says is: 'May I die *by* an anodyne necklace,' which looks as though, if some regarded it as a medicine, others had found it to be a poison."—*Saturday Review*, Jan. 12, 1884, on Mr. A. Dobson's "Vicar of Wakefield."

Is it not pretty clear that by "anodyne necklace" Goldsmith meant *the halter*—"an end to all my cares," as Sam Hall sings, with play of words alluding to the quack charm? However, all anodynes are poisons; and weakly babes *may* have died of the inhalation, an overdose for them.

A few lines further on, the Reviewer writes, "We are puzzled by the word 'sussarara.' Mrs. Symmonds says to her husband, 'Gentle or simple, out she shall pack with a sussarara.' Mr. Dobson quotes one authority which gives as the meaning of the word, 'a hard blow.' It is met with, in a slightly different form, in Sterne."

I have often heard my aunt (born in 1793) say of a delinquent servant, "She deserves a good *sesserero*" (so I should spell it, pronouncing as if it were Italian or Spanish). I always understood this to mean a scolding: there could not have been any question of striking. It is remarkable that domestic words of the other day should be already of doubtful meaning. HALLYARDS.

LETTERS RECEIVED AND SHORT ANSWERS.

WILLIAM MILLER. You will probably have gathered from a reply of mine to another correspondent how much I am in accord with you. But, as far as I am concerned, I am impotent in the matter.—F. G. S. Source of quotation previously pointed out by Mr. Smallpeice.—DR. LEWINS. Received, and carefully read.—BALANCE. Oh, dear, no! It is very possible, indeed, for an unskilful rope-dancer to fall while holding his balancing-pole. A little consideration will show that the centre of gravity of the performer must be vertically over the rope. If it gets outside of the vertical, and the man has no means of shifting it, over he goes. The use of the pole, which is heavily loaded at each end, is to shift the centre of gravity when needed, *e.g.*, if the man finds himself disposed to topple over to the right he moves his pole towards the left, and so brings the common centre of gravity of himself and the pole into a point whence a perpendicular would pass centrally through the rope.—SENEX. Sodium vapour arrests luminiferous vibrations of the same refrangibility as those which it emits; but not necessarily *all* such rays passing through it, unless it be of sufficient thickness. If I stretch half-a-dozen pianoforte strings across an opening and tune them all in unison to, say, A; and then on one side of that opening the note A is blown clear and loud on a cornet, it will be deadened to a certain extent, but a good deal of the sound will get through. By multiplying the number of strings, though, I might ultimately get sufficient to take up the whole of the undulations starting from the cornet, so that the cornet note should never reach the listener's ear at all. So with sunlight. It is partly arrested by the sodium vapour surrounding the sun; but some of it gets through, and if we destroy this latter portion by passing it through a sufficient thickness of terrestrial sodium vapour, we ultimately get the D lines really black.—F. W. H. I have been compelled to stop the discussion on mind and matter. *Inter alia*, it brings letters taking the forms of sermons, which I must perforce exclude, at the risk of being accused of admitting only one side of the argument. I just, however, record your recommendation to Mr. Alexander to read Haeckel's "Pedigree of Man" for himself.—TYCHO. It depends upon the meaning you apply to the word. Of old, lunatics were regarded as "moonstruck." For some curious details as to the supposed physical influence of the moon on sleepers in its light in tropical climates (to which you possibly refer), see Vol. VI. of KNOWLEDGE, pp. 305, 325, and 348.—REV. S. T. B. PEPPIN. I am sorry to exclude your temperately-written letters; but the reply to "Commentator" really assumes the form of an excerpt from a sermon. One thing is abundantly evident, and that is that you know nothing whatever of the writings of the greatest and most philosophical naturalist the world has yet seen. It is by no means necessary to "shut our Bible" before we "open our Darwin." So devout a Christian and good a Catholic as Professor St. George Mivart is a staunch evolutionist. Just consider how the Church has had to succumb on such scientific questions as the motion of the earth, its age, the date of man's first appearance on its surface, the origin of death, &c. This may possibly tend to abate a little of your "cocksureness" that the clergy *must* be right, and men of science wrong, on subjects which the latter have made the study of their lives, but of which the former are ludicrously ignorant. See the letter of "Meter" in another column as an example of the only way in which such a question as you raise can be discussed in a purely scientific journal. Note too my reply to "F. W. H." above, concerning the closing of the "Mind and Matter" discussion.—DR. BARNARDO. Thanks for your invitation, but I must once more reiterate that the whole thing is foreign to the purpose of a journal like this.—H. J. BIDDLE. The subject in which you are interested has never been treated of in these columns; and had it been, a rigid rule exists against the presentation of KNOWLEDGE gratis to any club, institution, university, or library whatever.—J. H. CORBETT. You would infallibly have trodden on some one's theological corns, and had I refused to insert a column or two of pulpit declamation in reply to you, I should have been charitably branded as "lending KNOWLEDGE to covert attacks on the faith," &c., &c. The amount of rampant bigotry existing in this last quarter of the nineteenth century would astonish you.—BRIN FRÈRES. Received.—THOROUGH BASS. I am ignorant of any work published in this country having special reference to Canadian farming, but you will find a mass of information which cannot fail to be of use to you in "Outlines of Modern Farming," by R. Scott Burn. Crosby, Lockwood, & Co. publish it, as they do also Youatt & Burn's "Complete Grazier," which is an encyclopædia of cattle-breeding and raising. Both of these are bulky books. I know of no very cheap ones that are worth anything.—OLD JOLLY. The conductor is, or will be in a few days, on the high seas (I trust not suffering from the height of the seas on). I do earnestly hope, though, that he will see your protest before he is "the death of" you! Should any such deplorable result ensue, I, as representing him *pro hac vice*, should certainly urge strongly on the proprietors of KNOWLEDGE the obligation they would be under to give you a public funeral, with a neat and appropriate brass over your vault, setting forth the circumstances under which you terminated. Why do you not employ some of your illimitable power of "chaff" in answering "Hallyards & Co."?—LIEUT.-COL. DOONER. Received.—CARL SIEWERS. Any and every book sent here is committed to an expert in the subject on which it treats, for careful perusal and review.—F. C. COLLINS. All the space available for such recreations is already given up to Chess and Whist.—J. OSBORNE, CONSTANT READER, and AN INDIFFERENT WHIST PLAYER. Shall be handed to "Five of Clubs" on his return.

Miscellanea.

NITROGEN is solidified at a temperature of −214° and under a pressure of 60 atmospheres, its critical point being −146° under the pressure of 35 atmospheres. By carrying the rarefaction to 4 mm. of mercury, the author has succeeded in obtaining a temperature of −225°. The solidification point of carbon monoxide is −207° with a pressure of 100 m. of mercury, Oxygen still remains liquid at a temperature considerably below −211°.

SIXPENNY TELEGRAMS.—The amendment which the new Postmaster-General intends to propose when the Bill comes on for discussion is one which, we imagine, will stand but little chance of being accepted by the House. His scheme is to allow addresses to pass free, to charge sixpence for the first three words of the message and a halfpenny for each subsequent word. This would operate most unfairly upon the best customers of the telegraph, who usually adopt sender's addresses of the briefest character. If anything is to be passed "free," it certainly should not be the sender's address, whatever may be urged in favour of so treating the address "To."

THE results of eleven months' use of toughened glass beakers are thus summarised by Mr. R. F. Friswell, in a paper read before the Chemical Society:—"Of twenty beakers, two burst spontaneously, = 10 per cent.; one burst on hot water being poured in, = 5 per cent.; six became useless from fissures and enfoliation, = 30 per cent.; eight are in good condition, = 40 per cent.; three have been broken by unknown means, = 15 per cent. Taking into consideration the loss of confidence caused by the high percentage of spontaneous bursting, it may be said that toughened glass is a complete failure in the laboratory.

Our Whist Column.

BY "FIVE OF CLUBS."

THE AMERICAN LEADS.

IT is noteworthy that much less is known about the so-called American leads in America than in England. Mr. Trist, of New Orleans, to whom these new principles (or rather these extensions of former rules) are due, communicated them to the *Field*, and there they have been under discussion by "Cavendish" and his school on the one hand, and on the other by "Mogul" and those who agree with him in regarding the modern system of play as at once too complicated and too clear. In New York I found few who knew anything about the American leads, and I waited till I reached New Orleans and had the advantage of Mr. Trist's own commentary on the new leads, before bringing them before the readers of KNOWLEDGE.

I have now fully examined the American leads, and have discussed them so far as was necessary, with Mr. Trist. I have even gone so far, in my anxiety to get information from headquarters, as to do what usually I do not care to do,—playing Whist with those not so fond of the game for the game's own sake as to play it without such added piquancy as money stakes possess for the less enthusiastic Whist brethren.

It is of course known to all who play Whist at all that from a suit of five cards not headed by such cards that a high card should be led, the lowest but one is the right card to lead. This lead, called the penultimate, has been extended to cases where there are six cards or more, in which case the lowest but two, or antepenultimate, is led. Many Whist players must have recognised the reasonableness of still further extending this principle, as by leading the lowest but three from a suit of seven cards. I think too that nearly every Whist player must have thought of the advantage which would arise if some distinction were made between the play from a suit of more than four and the play from a suit of four only, in other cases than those already provided for.

It is this want which Mr. Trist has met (and, as it seems to me, has effectively met), by the suggestion of the principles which I am now to describe.

Observe first that when we lead the penultimate from five, or the antepenultimate from six, we lead for the moment as if the cards below the one led, had no existence. We make, for instance, the same lead from King, Nine, Seven, Six, Four, Three, or from King, Nine, Seven, Six, Three, as we would from King, Nine, Seven, Six alone.

Now Mr. Trist proposes that in all cases where we hold more than four, we should—wherever it is possible—lead and follow the lead as if originally we had only held the four top cards of that suit; while, where this is not possible, he suggests a conventional system by which information may still be conveyed as to the original length of the suit.

The cases where it is possible to lead as from a four-card suit divide themselves into two classes:—

First, where a low card would be led originally: here we lead the fourth from the top according to the proposed system,—viz., the lowest but one from five, the lowest but two from six, the lowest but three from seven, and so forth.

Secondly, where a high card is led originally and followed by a low card: here we lead the proper high card, and follow with the original fourth card from the top. Thus from Ace, Queen, Ten, Five, Four, we lead the Ace and follow with the Five, instead of following with the Four as of old; from Ace, Queen, Ten, Five, Four, Three, we lead the Ace and follow with Five, instead of Three; and so forth. From King, Queen, Nine, Seven, with or without smaller cards, we play, according to the new system, King first and then Seven, instead of King first, and then lowest, as was formerly the rule.

The second class of cases is more important than the first, where indeed every case had been already provided for, except hands of more than six cards, which are unusual. Moreover, in cases of the second class the new rule is more effective in conveying information quickly, than in cases of the former class,—simply because more cards of the suit are played out. In fact, in every case of the second class the information given in the two rounds is bound to show that a long suit has been led from, and to indicate its precise length, or else that a signal has been begun by the enemy and withdrawn. Thus suppose the following two rounds, *A* being the leader:—

A	*Y*	*B*	*Z*
SA	*S2*	*S4*	*S8*
S7	*S5*	*SK*	*S10*

Here it is obvious that *A* holds the Three and the Six, for they have not fallen,—unless *Z* holds one of them, and played the Eight intending to signal, but afterwards changed his mind and withdrew the signal by playing the Ten. This last is very unlikely, nor does it affect *B*'s power of placing the higher cards in *A*'s hand. *A certainly* holds one of the two cards left below the Seven, and almost certainly he holds both; he also holds two of the three cards—Queen, Knave, and Nine; and the two must be either Queen and Nine, or Knave and Nine; for if he had held Queen and Knave he would have led one of them second round.

In the above case, only the knowledge accruing to *B* from the use of the new system of leading is considered; not any possible effect on *B*'s play. Suppose, however,—to take a convenient illustration of the effect of the proposed system, that, besides the Four and the King, *B* holds the Knave. Then, it is obvious that he is at once guided by the lead of the Seven to his proper course as third player second round. He knows that *A* holds the Queen and the Nine—of which fact (be it observed) he would have remained in ignorance had *A* led his lowest, second round. Therefore, if he plays the Knave he will block his partner's suit. He therefore plays his King, that his partner's suit may be cleared. Of course this would be his right play, anyhow; for the finesse of the Knave would clearly be unjustifiable. But in the following case *B*'s play is modified by the knowledge which his partner's play conveys (*B* holds Knave, Five, and Four):—

	A	*Y*	*B*	*Z*
1.	HA	H2	H4	H8
2.	H7	HK	HKn	HQ

Here *B* places in *A*'s hand two cards between the Ace and the Seven, which after *Y*'s play (but before *Z*'s) must be either Queen, Ten, or Queen, Nine, or Ten, Nine. If *A* holds the Queen it matters not how *B* plays; but if *A* holds the Ten, Nine, *B* can only do harm by retaining the Knave. Whether the Queen falls from *Z* or not, *B*'s Knave can do no good; but if the Queen *should* lie with *Z* then the third round falls to the Knave, if *B* keeps it and *A*'s suit is blocked.

Take again another case.

	A	*Y*	*B*	*Z*
1.	S A	S 2	S Q	S 10
2.	S 7	S K	Lowest Trump	S Kn

In this case *B* safely ruffs with his lowest trump instead of his best, because he knows that *A* only holds two cards above the Six, which must be the Eight and the Nine; were it not for the use of the "card of uniformity" *B* would have been in doubt as to the position of the Knave, and his proper course would have been to trump with his best.

(*To be continued.*)

A TYRO'S TRICK. Few things show Whist weakness and inexperience more than boasting of approaching success when sitting down to play, or claiming success, after it has been achieved, as evidence of superior skill. For every one who has learned anything of Whist knows that though superior skill must assure a balance of superior success in the course of a great many rubbers, the odds are very slight in favour of the most skilful players against the veriest blunderers at a single sitting. One of the finest players living lost 23 rubbers in succession, though most of the time he had an excellent partner. When you hear any one say, If you played with *our* club, you would lose money, you may be sure he knows nothing of the game; yet it would not be safe to infer that all or most of the members of his club are poor players.

WHIST CRITICISM.—When a man criticises another as a bad Whist player, without saying why he thinks so, it is well (if you wish to get at the truth) to ask him for his reasons. On sundry occasions I have elicited the following "exquisite reasons" for such general condemnation:—(i.) He played King the other day, third in hand, though he held the Ace. (ii.) He leads King from Ace, King, and others. (iii.) He leads King from King, Queen, and others. (iv.) He did not lead Clubs though he knew I had none, and that I had *plenty* of trumps to ruff with. (v.) He never leads trumps when he holds but one. (vi.) He goes on with trumps after he finds that he will be drawing two for one. (vii.) He positively led out his Ace, second round, from Ace, Queen, Ten, and another (after King, Knave had fallen), though he knew *Y* could trump the suit, for the play showed *Y* had two trumps left and he himself had only one (no one else had any). It is a compliment to be told by such people that they cannot understand your play, and the best compliment they can pay to be told by them that you play badly.

Our Chess Column.

BY MEPHISTO.

ILLUSTRATIVE GAME No. 2.

THE following game was played on the 14th inst. between Mackenzie (White) and Mason (Black) at the Hamburg International Chess Tournament. The game, which was very strongly played by the winner, exemplifies in a remarkable manner the effect of good development. Black very cleverly gained important time in the opening, and gradually increased the pressure of his attack until the life was crushed out of White's game:—

QUEEN'S SIDE, OPENING.

	White.	Black.
1.	P to Q4	P to Q4
2.	Kt to KB3	Kt to KB3
3.	P to K3	P to K3
4.	P to B4 (a)	P to QKt3
5.	Kt to QB3	B to K2
6.	B to Q3	P × P
7.	B × P	B to Kt2 (b)
8.	Castles	Castles
9.	Q to K2 (c)	B to Kt5 (d)
10.	B to Q2	QKt to Q2 (e)
11.	QR to Q sq.	Q to K2
12.	P to QR3	B to Q3 (f)
13.	P to K4	P to K4
14.	P to Q5	Kt to Ksq. (g)
15.	B to KKt5 (h)	P to KB3
16.	B to R4	P to KKt4
17.	B to KKt3	Kt to Kt2 (i)

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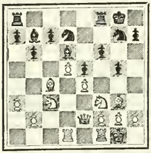

WHITE.

	White.	Black.
18.	Kt to K sq.	R to B2 (j)
19.	Kt to B2	Kt to B sq.
20.	Kt to K3	P to R4
21.	P to KR4 (k)	B to B sq.
22.	Kt to Kt5	Kt to Kt3
23.	P × P	P × P
24.	Kt × B	P × Kt
25.	P to B3	P to R5
26.	B to R2	Kt to R4 (l)
27.	Q to Q2 (m)	Kt(Kt3) to B5
28.	R(Qsq.) to Bsq. (n)	R to Kt2
29.	B to Kt5	P to Kt5
30.	B × Kt	Kt × B
31.	Q to Q sq.	P to Kt6

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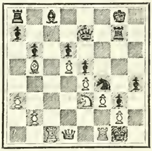

WHITE.

	White.	Black.
32.	R × B(ch) (o)	R × R
33.	Kt to B5	Q to Kt4
34.	Kt × R	Q × Kt
35.	R to K sq.	Q to QKt2 (p)
36.	B to B6	Q to Kt2
37.	R to R3 (q)	P to R6
38.	P × P	Kt × P(ch)
39.	K to Kt2	Kt to B5(ch)
40.	K to Kt sq.	P to Kt7!
41.	R to K sq.	R to B2 (r)
	Resigns	

NOTES.

(a) We learn by experience. The progress of this game, also previous examples of the same opening, shows that it makes a great difference in what order these moves are played. We think it desirable that both Castling and P to QKt3 should precede the move of P to QB4, the reason being that it would improve White's game if Black, by taking the BP, would give White a chance of retaking with the KtP. Black also gains time as in the text, for immediately White moves his KB, Black plays P × P, compelling the B to retake. For instance, if in reply to 4. P to B4, P × P. 5. B × P, P to QKt3, and it is White's move. But if in reply to 4. P to B4, P to QKt3. 5. B to Q3, P × P. 6. B × P we have the same position, but it is Black's move, or, in other words, Black has already on the 6th move wrested the advantage of the move from his opponent. Another advantage of Castling early is that by being enabled to play P to QKt3, in order to support the advance of the BP. White can also play B to QKt2, an important move which prevents Black from pushing forward to K4. It also makes it more dangerous for Black to take the QBP, as White eventually could bring the B to bear on Black's K side by P to Q5. For clearly, if the QB is not played to QKt2, then P to K3 blocking the B becomes worse than useless.

(b) Now, Black's QB is well posted, whereas White's KB attacks nothing, and his QB is blocked in.

(c) With the intention of advancing P to K4.

(d) Making P to K4 impossible, on account of B × QKt; also with a possibility of B × Kt followed by Kt to K5.

(e) Now, B × Kt would have enabled White to retake with B and get it into a position where it might be a little more useful than it is a present.

(f) Again occupying a commanding position.

(g) Necessary, in order to prevent Kt to R4 and Kt to B5, also providing a fresh line of play suitable to the alteration in the position.

(h) Putting the B in a position where he can be conveniently attacked by Pawns. As a general rule, it is always safe to advance the Pawns on the K's side when the opponent's KB is blocked by a P on Q5. Perhaps B to Q3 would have retarded Black's advance.

(i) The strength of Black's play consists in the principle not to push an attack rashly, but to advance steadily, and strongly supported. Every inch of territory is occupied by him before advancing. He does not at once push on the KP, but brings his forces well to the front, and to bear upon the intended advance, which increases thereby in effect.

(j) White brings his Kt over to K3, via B2, where he seems better posted, and Black intends playing his QKt over to his K side.

(k) P to R3 is safe, this weakens White's position still more.

(l) Every move tells. Black prevents White from moving his KtP as a last resource.

(m) Here Q to K sq. suggests itself with a view to the possibility of playing P to KKt4, in order to arrest Black's progress.

(n) Played with a view to taking the B in order to relieve his game if possible that way.

(o) With that B on the board, Black's intended advance of the RP would become more dangerous.

(p) It is difficult to see a reason for this move except it be to entice White to play B to B6. This B is wanted on B sq. to prevent the advance of the KRP.

(q) White ought to have retired his B to Kt5, which would have enabled him to play B to B sq. in case White played P to R6, and if P to R7 (ch), K to R sq., it is not easy to say how White could win.

(r) A worthy termination of this well-played game. Black might have won the exchange by Kt to R6 (ch.), K to Kt2, P to Kt8 (ch.), R takes Kt × R (ch), but the move of R to B2 is far more effective, as Black now threatens to play Q to Kt6 and mate with the Kt, R to B2 being played to prevent B to Q7. Of course, if either K to R2 or B2, Black wins easily.

CONTENTS OF No. 194.

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CONTENTS OF NO. 196.

MYSTERIES AND MORALITIES.

BY EDWARD CLODD.

III.

A FEW isolated specimens and titles of lost plays excepted, the English Mystery Plays are usually, and hitherto correctly, described as comprised in three series—the Chester, the Coventry, and the Towneley, which last is sometimes called the Widkirk, or Wakefield.

The number is now increased to four by the recent publication of the York Plays, which fully equal in value, and perhaps surpass in antiquity, the foregoing collections. The existence of this important collection was unknown even to Mr. Collier, who, in the revised edition of his "History of Dramatic Poetry," published in 1879, speaks of the *Skryvener's Play* on the incredulity of St. Thomas, as "the sole relic of a series of religious dramas formerly exhibited at York."*

The York series is printed from a manuscript in the possession of Lord Ashburnham, in the editing of which Miss Toulmin Smith has brought together a mass of interesting detail from the municipal records of York, throwing much light on the history of the plays.† The original versions of these several series have, in their passage from copyist to copyist, and in their adaptation to suit varying local tastes, undergone such alteration that the exact date of their composition cannot be determined. The *Chester* collection,‡ containing 25 plays, has long been regarded as the oldest, its composition being referred by local antiquaries to the middle of the thirteenth century, when, according to tradition, the earliest performances took place under the mayoralty of Sir John Arnway.

* Vol. II. p. 71.

† *York Mystery Plays:* the plays performed by the Crafts or Mysteries of York on the day of Corpus Christi, in the fourteenth, fifteenth, and sixteenth centuries. Edited by Lucy Toulmin Smith. (Oxford: Clarendon Press. 1885.)

‡ *The Chester Plays.* Edited by Thomas Wright, for the Shakspeare Society. Two Vols. 1843 and 1847.

His name appears in the first verse of the Banes "reade before the beginninge of the plays."

"Reverende lordes and ladyes all,
That at this tyme here assembled bee,
By this messange understande you shall
That some tymes there was mayor of this citie
Sir John Arnway, Knighte, who moste worthilye
Contented hymselfe to sett out in playe
The devise of one Done Rondall, moonke of Chester Abay."

The evidence in support of so early a date is, however, slender, and the manuscript from which the foregoing lines are quoted was transcribed three and a half centuries later, namely, in 1600. Its learned editor, Mr. Wright, is of opinion, from the phraseology and form of words which may frequently be discovered in the blunders of the modern scribes, that the original manuscript—from which it and another copy dated 1607 were made was of the earlier part of the fifteenth or the end of the fourteenth century."*

The *Coventry* series,† comprising 42 plays, is contained in a quarto volume preserved in the Cottonian collection of manuscripts in the British Museum. The date of this relic, 1468, is ascertained from its fortunate insertion on one of the folios by the transcriber, presumably a member of the Order of Grey Friars of Coventry, under whom the plays were first produced.

The *Towneley* collection,‡ containing 32 plays, is so called from its possession by the Towneley family, at whose hall in Lancashire it was preserved until the recent sale of their library. The plays, written on folio parchment, and ornamented with elaborate initial letters, were, in the opinion of their editors, the composition of the friars of an abbey formerly situated at Widkirk, or Woodkirk, near Wakefield. The performances probably took place at the fairs held outside the abbey-gates, until their transference, in the lapse of time, to Wakefield, where the guilds played them for the recreation of the burgesses. They are written in a Northern dialect, but little modernised, akin to that of the York series, sprinkled with words of Scandinavian origin, and are supposed to date from the close of the fifteenth century, a few years later than the Coventry collection.

The manuscript of the *York* series, comprising 48 plays, performed with the sanction and authority of the corporation, once belonged to that body and was prepared after "A.D. 1415, with the intention of entering all the plays in their due order, with the names of the crafts then performing them." The experts at the British Museum consider the handwriting to date between 1430-1450, and the editor, arguing from the style and metre, and especially from references at the end of the fourteenth century to the plays as of "old time," places their composition in the middle of that century, not long after the appearance of the *Cursor Mundi*,§ with the subject and general arrangement of which poem they have much in common. If this be so, there is strong argument for regarding the York series as the oldest of the four, certainly as preceding the Towneley, five of the plays in which are almost literal transcripts of corresponding plays in the York collection. It may be that both sets are variants of lost originals.

* Introduction, p. xvi.

† *Ludus Coventriæ*, edited by J. O. Halliwell-Phillips for the Shakspeare Society. 1841.

‡ The *Towneley Mysteries*, edited by Dr. Lingard and others for the Surtees Society, 1836. The manuscript is now in the possession of Mr. Quaritch.

§ *The Cursur o the World:* a Northumbrian poem of the XIVth century. Edited by the Rev. Richd. Morris for the Early English Text Society. 1874-1878.

The feature common to the four collections is their combination of the leading events narrated in the Bible into a consecutive whole, but with considerable difference both in the subordinate parts and in the proportion of plays based on legends outside the canonical books of Scripture, *e.g.*, the popular mediæval legend of the Fall of Lucifer, which has great prominence given it in the *Cursor*, in the poems of Cædmon and other early writers, and of which Milton makes such effective use in *Paradise Lost*, is the subject of a Mystery in the York and Chester Series, but is absent from the Coventry and Towneley. The Coventry Series has no plays founded on the apocryphal books of the Old Testament, but several founded on those of the New Testament, as the Jealousy of Joseph, the Trial of Mary and Joseph, and others, whilst in the Chester Series, only one play, based on the legend of Christ's descent into hell (which, however, may have vague reference in the Epistle of Peter),* has its source in the apocryphal books. A comparative table of the four collections which is given in the Introduction to the York Plays enables us to see at a glance what plays are common to all.†

It is obvious that when the plays were popularised by their translation from Latin or French into a tongue "understanded of the people," a good many extraneous elements were introduced, and those chiefly of the mirth-kindling sort, according to the dramatic skill and humour of the transcribing adapter, and to the public appetite, whether of boors or townsfolk, to be whetted. Thus the Chester Banes tell how Done Rondall, "moonke of the Abay,"

> "in scriptures well seene,
> In storyes travilled with the beste sorte,
> In pagentes set fourth apparently to all eyne
> The Olde and Newe testament, with livelye comforth,
> Interminglinge therewith, onely to make sporte,
> Some thinges not warranted by any writt,‡
> Which to gladd the hearers he woulde men to take yt"

The qualities attached to certain characters became more extravagant as the players depended more for success on fun and burlesque, and as the audiences demanded some new sensation or excitement to mirth, in the main of harmless sort. For even the grossness which is no uncommon feature of the plays, notably in the Towneley, was due not so much to low moral tone in actors and spectators, as to lack of refinement and the unstudied plainness which calls a spade a spade. Moreover, the plays are often obviously founded on French originals, in which there was no lack of laughter-compelling scenes. In the early miracle-play of S. Nicholas, the vulgar conversation of pot-house gamblers is a mirth-provoking incident; in the Towneley mysteries, Cain brawls, and bullies his hind like a coarse and vulgar Yorkshire farmer; in both the Chester and Towneley series Noah's wife is a termagant, and the quarrels between the two are full of comic dialogue; in the "Shepherds," the most popular play of all, the rustic realism is prominent in amusing, and, as quotations will presently show, in farcical form, while its introduction is of value as illustrating the habits, language, and food of the rural classes in the fourteenth and fifteenth centuries; in the York series, Judas is ridiculed by a porter; Pilate outwits a squire who sells a plot of land for thirty pieces of silver paid to the traitor, and gives up the deeds without securing the money; in many of the pageants where the devil is a character, he appears only to be laughed at; while hell-mouth, as will be seen hereafter, was a great clerical hit. The anachronisms and classical allusions are amusing, as when Noah's wife swears by Christ, the Virgin Mary, and St. John; Pharaoh and Cæsar Augustus by "Mahoune," and Balak by Mars; when Herod asks his council what they find "in Vyrgyll, in Homere," regarding the birth of Christ, and promises to make one of the connsellors Pope; when the Sybil prophesies before Octavian of Jesus and the Judgment, and when the watching shepherds Harvey, Tudd, and Trowle drink "Halton ale," and quote Virgil as among the prophets. But nowhere, apparently, do the characters of Jesus and his mother appear shorn of dignity or of qualities for reverence; * while the woman is never wholly lost in the glory of the Virgin Mother, as when, in the Flight into Egypt, she clings to the protection of Joseph. In Abraham's sacrifice the struggle between fatherly love and submission to the decree of heaven is treated by the dramatist with combined tenderness and dignity. In the Coventry variant when Abraham is dumb with grief, Isaac says:

> Fayre fadyr, ye go ryght stylle,
> I pray you, fadyr, speke unto me.

Touches, &c., of current life and usage here and there stand out amid the ancient story; the carpenter's tools and measurements used by Noah, as well as those employed at the Crucifixion; the bitter cold weather at the Nativity, telling of a truly northern Christmas; the quaint offerings of the shepherds; the ruin of the poor by murrain in the account of the ten plagues; the drinking between Pilate and his wife; the sleeping of Herod; and the excellent representation of a heavy manual job by a set of rough workmen in the Crucifixion. Illustrative, too, of English custom and forms of justice are the borrowing of the town beast; Judas offering himself as bondman in his remorse; the mortgage of a property (raising money by wed-set); and the trial scenes in certain plays, in which Pilate "in Parlament playne" vindicates the course of law, and puts down the eager malice of the accuser Caiaphas and the sharp pursuer Annas.†

The most ancient extant English Mystery play ‡ is based on the legend of the descent of Christ into hell to liberate Adam, Eve, John Baptist, and the Prophets, as narrated in the apocryphal gospel of Nicodemus.§ It probably formed one of a series no longer in existence, and is, in the judgment of Mr. Collier and other authorities, not later than the earlier part of the reign of Edward III. An analysis of this popular play will be more in place when treating of the general contents of

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* Ch. iii., 19. "By which also he went and preached unto the spirits in prison."

† Pp. lxii., lxiii.

‡ In the Prologue to the *Coventry Mysteries* the vexillator says:
"ffor we purpose us pertly stylle in this prese (crowd)
the pepyl to plese with pleys ful glad,"
to which Mr. Halliwell-Phillips adds this quaint analysis of the different kinds of plays and players from the *Harleian MS.* 221, fol. 129:—
"Pley, ludus; pley, or somyr game, spectaculum; pley that begynnythe with myrthe and endythe with sorowe, tragedia; pley that begynnythe with sorrow and endythe with myrthe, comedia; playere lusor; playere that alwey will pley, ludibundus."

* In Archdeacon Roger's records of the Chester Plays (*Harleian MSS.*, 1944) reference is made to the custom of gilding the face of the actor who played God, and to a request that as this gilding "disfigured the man," the omission of the Deity might be pardoned, and that the audience would not expect God "to appear in shape or person," but in "a cloudy covering."

† *York Mystery Plays*, Introduction, lvii.

‡ *Harleian MSS.* No. 2,253. Brit. Mus. Printed in Mr. Collier's *Five Miracle Plays*.

§ Cf. Cowper's *Apocryphal Gospels*, pp. 303-311.

the four collections, in each of which it occurs in longer or shorter form.*

Among the few other detached plays, there are, in addition to the *Skryvener's* play of S. Thomas mentioned above, three preserved among the Digby manuscripts in the Bodleian Library, having for their subjects, with addition of much irrelevant matter, the story of the Conversion of S. Paul, of Mary Magdalene, and the Slaughter of the Innocents. One devil named Mercury enters with thunder and "a fyeryng, comyng in hast, cryeing and roryng," and informs "Belzal," with dismay, of the Apostle's conversion, expressing his opinion that "the devyl's law will now be clene downe layd." The two agree to stir up the Jewish Bishops to interfere in the matter, and then "vanyse away with a fyre flame and a tempest." Mary Magdalene lives in a castle which the Devil, with the aid of the Seven Deadly Sins, besieges, and the history of Mary's fall follows. The handwriting of this manuscript is of the reign of Henry VII.

Among the lost plays, Miss Toulmin Smith† refers to one, perhaps belonging to a series called the "Play of the Lord's Prayer," of which Wyclif, who died in 1384, speaks in his advocacy of the translation of the Bible as the "paternoster in English tongue, as men seyen in the play of York." Is would appear to have been more of the Morality type, certain qualities being personified, and was so popular that a guild of men and women was established for the purpose of keeping it up. Another series of lost plays, based on the *Creed*, was performed in York every tenth year by the guild of Corpus Christi, and there was also, in the same city, the universally-acted play of S. George, which elsewhere, as at Windsor, was exhibited more as a spectacular pageant or pantomime (*i.e.* in dumb show) than as a drama, the saint "ridyng and fightyng with the dragon, with his spere in his hand."

* *York Mysteries*, No. 37, "Harrowing of Hell." *Chester Mysteries*, No. 18, "Harrowing of Hell." *Coventry Mysteries*, No. 33, "The Descent into Hell." *Towneley Mysteries*, No. 25, "Extractio animarum ab inferno." Cf. also *Cursor Mundi*, ll. 17,849–18,450.

† *York Mysteries*, xxix., and see also Appx. II., pp. lxiv.-lxviii. for complete list, as far as known, of places and plays in Great Britain and Ireland.

NOTES ON MAPPING.

By Richard A. Proctor.

(*Continued from p. 8.*)

THE EQUIDISTANT PROJECTION.

THE equal surface projection dealt with in my last paper on mapping, though useful for special purposes, is of course not suited for general use in atlases. Equality of area can only be obtained at the expense of considerable distortion, even when a portion only of the surface of a globe is presented: when a hemisphere is shown, the distortion is still greater; and it becomes excessive when the whole globe is presented,—though this, of course, must be the same with all methods of projection.

I have by no means done with the subject of equal-surface projection. I shall have hereafter, a good deal more to say, even about the special method of equal-surface projection which I dealt with in my last paper. There are other methods of presenting portions of the globe, or the whole globe, correctly as regards area,—as for instance the extension of Flamstead's method, and the cylindrical equal-surface projection, which I devised in 1867.* These methods are described and illustrated in my "Essays on Astronomy," but as that work is nearly out of print, and no new edition will be issued, I shall shortly take occasion to describe the methods in these pages.

For the present, I turn from the equal-surface projection, to the equidistant projection, which I take to be on the whole, by far the best projection for all maps of large portions of a globe's surface, and to be theoretically the best also for maps of small portions, though practically, the conical projection, owing to the much greater ease with which it can be drawn, will probably be always preferred for showing small areas,—as countries like England, France, Spain, on the earth, and constellations on the globe.

In reality, neither the equal-surface nor the equidistant methods are projections at all. For, a projection of outlines on a spherical or other curved surface signifies the curve in which straight lines drawn from a fixed point to all points on such outlines, meet some other surface, plane or curved. A projection in mapping is always made on a plane surface. The Gnomonic, Stereographic, and Orthographic projections, are all properly called projections. The equal-surface method described in my last may be conceived as a sort of double projection: for, if the sphere be supposed to rest in a hemisphere of twice its radius, and from the highest point of the sphere, all outlines on the sphere are projected upon the hemisphere: and then from a point at an infinite distance vertically above the hemisphere, the outlines so obtained are projected upon a horizontal plane, the projection thus formed will be the central equal-surface projection described in my last. The so-called equidistant projection is not however a projection even in this sort; but purely a method of construction.

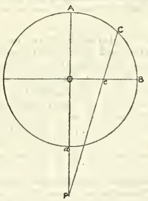


Fig. 1.

It is true a projection *called* the equidistant and sometimes the *globular* was suggested long ago, by the French mathematician Lahire, in which a point P (Fig. 1) was taken at such a distance on A O *a*, a diameter of the sphere, produced, that a straight line P C, to C the bisection of the quadrant A C B, bisected A B in *c*. But this method does not project all equal arcs along A B into equal lines along O B. Nor has it any practical value whatever. I doubt if even Lahire himself ever thought it worth while to construct a chart on this plan. Delambre suggested the true equidistant construction, which may be defined as *a construction in which all points*

* It was subsequently re-invented by Professor P. Smyth, and employed to show that the Great Pyramid is the centre of the land-surface of the earth – which is absurd; to such base uses may the best laid plans of men (and mice) be brought!

are represented in their true direction from the centre, and at their true distance as measured on the globe. The meridians and parallels in the maps of hemispheres given in most atlases are not on the true equi-distant construction, though they approximate to it fairly enough. They are obtained by dividing two diameters E D E′ and P O P′ of the circle P E P, Fig. 2, crossing at right angles into eighteen equal parts in *a b c* &c. each quadrant P E, P E′, &c. into which they divide the circle into nine equal arcs in A, B, C, &c. Circular arcs P *a p*′, P *b* P′ &c., give the meridians and circular arcs. A *t* A′, B *s* B′, &c., give the parallels of latitude. To show that this construction differs appreciably from the true equidistant construction, we need only notice that in the latter the parallels corresponding to A *t* A′, B *s* B′, &c., meet the circumference P E P′ E′ at right angles, which is obviously far from being the case with the circular arcs A *t* A′, B *s* B′, &c.

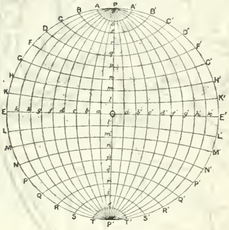


Fig 2.

Turning to the true equidistant construction:—

It is easy to determine the rate at which scale and shape vary in this construction. Distances measured from the centre, or along any part of a radial line, are by the very nature of the projection correct. Thus if A (Fig. 3) is the centre of the globular surface to be presented, and A K B an arc on the sphere, A K B is shown in the projection as *a k b* (Fig. 4), a straight line, such that

$$ab = AB;\ ak = AK;\ kb = KB.$$

Hence circles on the sphere, having A as its pole (B D E, K L F, Fig. 3, represent quarters of such circles) are

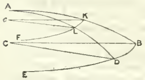


Fig. 3.

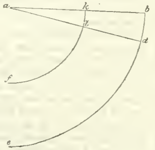


Fig. 4.

represented as circles *b d e*, *k l f*, in the construction. But the radii of the circles B D E, K L F, on the sphere are B C and K *c*, the *sines of the arcs* A B and A K, whereas the corresponding circles in the construction have radii *a b* and *a k* equal to the *arcs* A B and A K. Hence we see that while the scale does not differ radially in the equidistant construction from the scale on the globe itself, it is larger transversely to the radius, in the same degree that the *arc* distance on the globe is larger than the *sine of the arc*.

Of course this is a defect; and if it were possible by any method of construction to get rid of all defects, in the representation of part of a globe upon a plane surface, then we should have to reject the equidistant construction on account of this particular fault. But as this is not possible, we have to inquire whether any other construction is on the whole more suitable, or characterised by smaller defects.

Several authorities, from whom one does not care to differ, consider that the equidistant projection should not be used—as it always is—for maps of hemispheres in our atlases, because the projection thus gives different scale-variations in different directions, from no variations at all along a radius, to an increase in the proportion of 15,708 to 10,000 transversely to the radius at the outside of each hemisphere. Professors Hughes and Nichol, and Sir George Airy, have given their verdict in favour of the stereographic projection for the purpose of showing hemispheres. I imagine, however, that they have none of them drawn charts of more than one pair of hemispheres on the stereographic projection. If they had, they would hardly assert, as they do, that the continents are represented of their true shape in this projection; for, Africa or South America, in a stereographic projection, with the south pole as centre presents a very different shape from the same continent on a projection having a point on the equator as centre. It is true that, in the stereographic projection, the scale at any point is greater in the same degree radially and at any angle whatsoever to the radius, than the scale at the centre; and if we were in the habit of measuring short distances on charts of hemispheres, this would be an important advantage. But as we never do this, and as large distances are affected in no such uniform manner, the stereoscopic projection has no advantage over the equidistant in regard to uniformity of scale-variation; while as regards amount of scale-variation it is altogether inferior, the increase at the border of a hemisphere being as 2 to 1, in the stereographic (radially and transversely both) as compared with 1 to 1 radially and 1·57 to 1 transversely, in the equidistant construction.

As to change in area-scale, a much more important point in maps of large portions of the globe, the stereographic projection compares still worse with the equidistant; for while the areas at the border of a hemisphere on the equidistant projection are only larger than those at the centre, as 157 is larger than 100, or not much more than as $1\frac{1}{2}$ to 1, they are four times as large in the stereographic projection.

Thus the equidistant construction is much better than the stereographic for maps of hemispheres in ordinary atlases. For sailors' charts, as I shall hereafter show, the stereographic projection is the best of all, and, except for rhumb-sailing, ought long since to have replaced Mercator's. But for atlases, in which the maps of hemispheres are intended to give a good general idea of the positions and (as far as possible) the relative dimensions of different parts of the earth, the equidistant projection is much the best.

The great fault of the maps of hemispheres in our atlases, is that only a pair is given, and this pair always the same. The learner always sees Africa, Canada, and Greenland, Siberia, Australia, and New Zealand distorted

Map of Hemisphere having centre in E. long. 30°, N. lat. 38°, on the true equidistant construction.

and enlarged *in the same way* and naturally falls into the mistake of supposing that these false shapes and sizes are correct. Were a different pair of hemispheres introduced, at any rate in the larger atlases,—as for instance a northern and a southern map, two maps having Greenwich and its antipodes as centres—the erroneous ideas thus conveyed would be to some degree corrected.

The chief value of the equidistant construction consists, in my opinion, in its suitability for maps of large portions of the globe, celestial or terrestrial, not in its use for hemispheres. It is more useful for these than any other projection; but maps of hemispheres, at least as parts of an atlas, are not nearly so important as maps of continents or of countries.

I illustrate first, however, the use of the equidistant projection for maps of hemispheres; as this point naturally comes first under consideration, this being the use for which the construction was originally suggested. I believe, indeed, that until the publication of my "Constellation Seasons," my "Library Star Atlas," and my "School Star Atlas," which, (like my "Stars in their Seasons," and the maps of my "First Star Lessons," now appearing in these pages) are equidistant, no maps of regions less than a hemisphere were ever drawn on this construction.

In the accompanying map we have a hemisphere of the earth on the true equidistant construction,—the centre of the map being a point in east longitude 30° and north latitude 38°. The special object aimed at in the construction of this chart, has been to present, as correctly as can be done on a plane, the immense island formed by Europe, Asia, and Africa together. (Following the precedent of those geographers who call Europe and Asia together Eurasia, we may call this great island Eurafrasia.) The Atlantic Ocean is more satisfactorily presented in this map than in any given in our atlases. But a point in longitude 40° W., or 70° further west than the centre of our map, is better suited to show the Atlantic. The student will find it a pleasant and instructive exercise to draw such a chart, using the same

meridian-lines and parallels as in the accompanying map, but taking the central meridian to represent the meridian 40° west of Greenwich.

(*To be continued.*)

PHOTOGRAPHY AND MEDICAL JURISPRUDENCE.

By WILLIAM MATHEWS.

II.—THE GALTON COMPOSITES IN THEIR RELATION TO THE DETERMINATION OF IDENTITY.

THE achievement of consolidating into a single typical photograph the portraits of six or seven separate sitters has naturally awakened some curiosity. Other and even more remarkable operations may be expected to follow. Little by little, the field of inquiry will extend itself. In the natural course of evolution, possibilities will loom into view that, thus far, are not within the scope and purpose of the experimentalists.

One of the more inevitable of these approaching developments falls so entirely within the pathway of procedure that its investigation cannot be much longer postponed. In this very novel portraiture of the "composite order" there are some attendant phenomena that are of a nature at once to challenge observation and to lead in the direction indicated.

At the very threshold it becomes apparent that due attention has not been yet conferred upon the conjointure —certainly under less exacting conditions—of an arranged series of the photographs of the self-same sitter. Of such photographs, it is obvious that their superstructure should be constituted of portraits taken at definite and well-separated epochs.

The changes which ensue from youth to maturity and from maturity to decadence are clearly amenable to certain physiological limitations. These, by this time, photography might have definitively elucidated. The "Seven Ages" of the dramatist display, we may rest assured, various "points in common" which the photographer, as well as the psychologist, might now-a-day detect and investigate. That the "boy is father to the man" is admitted. But what a portrait will that be in which the boy, the lover, the soldier, and the justice are conjoined into one harmonious photograph! That will be a "modern instance" worthy of the age!

In the "Galton composites" it has been noted that, in those that are the most successful, the final outcome is in some particulars more effective and life-like than are the separate portraits of the members of the group. If the question be here mooted, tentatively, Whence comes this curious and unexpected consequence? it is hoped that it may not be deemed waste effort.

It should be recognised that the picture assumes in some degree the aspect of being in relief. The appearance might be fitly called "medalesque." How happens this? In reply, it may be pointed out that, in a kindred branch of art—in all such engravings as are designed to assume the appearance of medallion-work or *basso-rilievo*, the artist adopts a given expedient which is readily appreciable. Along the margins, between the half-tones and the darker outlines of the engraved work, there is always interposed a zone of absolute white, representative of the play of light upon the illuminated edges of the design.

Similarly, it will always occur that in the case of superposed portraits, and, *à fortiori*, in those in which the outlines are the more perfectly conformable, a broken zone of lighter tinge will skirt the outer shadows, just where the "points in common" the most manifestly approximate.

Here, then, we obtain a glimpse of the conditions under which this effect shall become the most obviously pronounced in its degree. And, in this connection, it must be regarded as already experimentally ascertained that, in the instance of an individual who has reached maturity, the typical form of the face will thenceforward be maintained without manifest or appreciable departure.* It is clear that, under such circumstances, the fiducial lines remain in unison, and that there will arise no difficulties in effecting the absolute super-imposition of the portraits.

Meantime, let it be regarded as inevitable, that in the interval between two or more sittings the sitter has become either more plump or more attenuated. Whichever event has happened, the super-imposition will be attended with an identical issue. Interposed between the half-tones of the facial areas and the exterior marginal shadows there will appear narrow belts of lighter tinge, by which the coupled images will be differentiated.

From this vantage-ground, therefore, we betoken the assured attainment of a novel and artistic result in photographic portraiture. This it is for the ingenious to develop. More to our present purpose is the consideration that medical jurisprudence may find here the adjunct of a new and undubitable test of personal identification. Here, if anywhere, we may catch sight of "that function which science asks of photography, and which medical jurisprudence is entitled to ask of both."

Need it be added that this presumed *terra incognita* has been already practically, if but partially, explored, and that it now awaits only that formal annexation to the ever-extending realms of science which, sooner or later, must inevitably take effect.

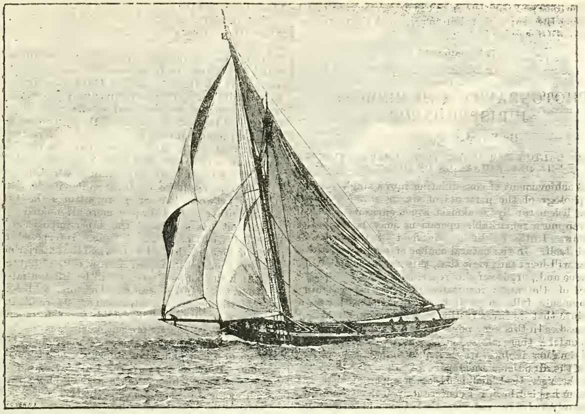
THE "GENESTA."

THE greatest sporting event on the water this year will be the international yacht race for the *America's* cup, held under the auspices of the New York Yacht Club. Great interest is being manifested by the yachtsmen and others throughout the whole country in the coming contest, while the patriotic pride of many wealthy men in the race has been aroused to such a pitch that they have ordered several new and costly yachts to be built for the protection of the cup. Even General Butler has dropped politics (and law) long enough to say that he wants to enter the ancient *America* in the race. England will send two very fast yachts, with the hope that one of them will walk away with the prize. These are the cutters *Genesta* and *Galatea*. The former is the favourite, and seems to be most feared by the Yankee yachtsmen.

It is understood that the match is to be three races, best two to win—one a triangle 40 miles, one over the New York Club course, and the third, if necessary, 20 miles and return, starting from Sandy Hook.

The *Genesta* was built by Messrs. Henderson Bros., at Partick-on-the-Clyde. She is 90 ft. over all, 81 ft. on the water-line, 15 ft beam, $11\frac{3}{4}$ ft. depth of hold, and $13\frac{1}{2}$ ft. draught. Although originally she had only 60 tons of lead outside, she now carries 70 tons of lead on her keel.

* In the conjointure of a photograph of Mr. Gladstone, of thirty years *ante*, with one of the present date, this effect is strikingly illustrated. In such case each portrait receives its due modicum of exposure.



The English Cutter *Genesta.*

She has also been recently coppered and fitted with new and heavier spars. Keelson stringers, frames, and strengthening plates are all of steel, while the planking is teak and elm.

With great accommodations beneath, the cutter's fittings are plain but substantial. The deck fittings present several novelties. The bowsprit comes over the steam-head in the centre of the yacht, with more than the usual difficulties in reefing it. To obviate this difficulty, one of the checks of the steel bits is hinged. This device permits of the bowsprit heel being swung round clear of the scuttle and the capstan, and run aft alongside the mast. The fore scuttle, oval in form, is a steel tube, round which the wire-fall of the bobstay tackle is coiled in easier turns than it would be belayed in the ordinary way. Just before the mast is a second scuttle, which accommodates the steward, and also the crew, on racing days. Behind the mast is a third scuttle, down which canvas can be lowered into the sail-room under the cabin sole.

The *Genesta* will be without any provisions for screening the weather spray besides a racing cabin. The *Genesta* has a fine saloon, fitted up lightly and elegantly, a ladies' cabin aft, and spacious accommodations for the crew, steward, and captain. The whole length of the yacht has been utilised, and the space obtained is remarkable. The *Genesta* is to be in charge of C. Carter, who is well known on the Clyde as a clever yacht sailor. She is owned by Sir Richard Sutton. Our engraving is taken from an instantaneous photograph, representing the *Genesta* ploughing through the water at full speed; it clearly shows the wave-line, and indicates the ease with which she parts the water. All through the yachting season last year this boat met the best of the British fleets, and, although not always a winner, she proved herself to be, without doubt, the best "all round" boat in the kingdom.—*Scientific American.*

ILLUSIONS OF THE SENSES.

By RICHARD A. PROCTOR.

(Continued from p. 63.)

It is, however, the sense of sight which has most thoroughly deceived the student of science, almost justifying Professor Le Conte's statement that no evidence is more misleading and fallacious than the evidence of the senses. So far from seeing being believing, one recognises that often we see an object wrongly tinted, wrongly illuminated, wrongly shaped, besides that fault of wrong apparent size which we might expect to recognise in the case of a sense like sight (which gives no direct evidence as to distance).

Taking this last defect of sight-evidence first, we note that the eyesight cannot really be said to delude us when it seems to tell us that—for example—the moon is as large as the sun. All that sight really tells us is that the sun and the moon occupy fields of view of the same apparent size. This, of course, is correct information as far as it goes, and the sense of sight cannot go further. But the sense of sight conveys false ideas to the mind sometimes even about apparent size.

Perhaps the most remarkable case of the kind—at any rate the most familiar—is the apparent increase of the sun and moon in size as they approach the horizon. Singularly enough, Professor Le Conte does not regard this as an optical illusion; "the visual angle being in

both cases precisely the same, the size of the image on the retina must have been the same." But one might with equal reason say that none of the illusions relating to touch or heat are really illusions, seeing that the actual effects produced on the nerves of touch correspond with the actual shapes or temperatures of the objects felt. In every case of sense illusion the nerves give correct information, it is the interpretation of the information which is incorrect.

The apparent largeness of the moon near the horizon is of course a real illusion. It is often elaborately explained as due to the magnifying power of the layers of air through which the moon is viewed. In the "Wide Wide World" the overwhelmingly wise John Marchmont explains the matter thus to Ellen Montgomery (I hope my recollection of the names is trustworthy, but the book came out a long while ago, and I have not seen it since its first appearance). But the moon is not magnified at all in *that* sense. She does not occupy a larger space in the visual field. Nay she looks rather smaller when near the horizon, being then nearly 4,000 miles nearer to us than when overhead. It is easy to show this; and in passing I cannot too earnestly recommend those who wish to form correct ideas about the apparent sizes, shapes, positions, and movements of the heavenly bodies, to test such matters in simple ways such as I am about to suggest in the moon's case. Cut out in card a circle exactly half an inch in diameter, leaving a projecting piece of card outside some part of the rim. Then take a straight rod about 54 inches long, and with a tack through the projecting piece fasten the disc at one end of the rod, so that the whole disc is visible from the other end. Now it will be found that if the rod be directed towards the moon, the disc of card at the end furthest from the eye, will just hide the moon from an eye placed at the nearest end. Whether the moon is high up in the sky or close to the horizon the same thing happens. The moon looks just as large high up as she does low down, on any given night. Of course, as the moon's path round the earth is not quite circular there is a change in the moon's apparent size in the course of each lunar month,—a change which the method of measurement just described will serve very well—rough though it is—to indicate. Just as the sun varies in apparent diameter as the year progresses, his diameter on January 1, bearing to his diameter on July 1 the ratio 31 to 30, so the moon varies as the month progresses, and in greater degree. But look at the moon from one end of the rod when she is rising and you will find the card disc at the other end cover her either exactly or very nearly, and when she is at her highest on the same night you will find her as exactly or as nearly covered by the card disc the rod being directed in the same way towards her, and the disc viewed by an eye placed at the other end of the rod.

Here then is an optical illusion by which the idea is conveyed that the moon is larger when low down than she is when high above the horizon, though in reality occupying as large (nay, even a slightly larger) portion of the visual field. It is the same with the sun, and the same also with any one of the familiar star groups which pass from close by the horizon to a great distance above it. How is this deception to be explained?

The increase of the moon's size near the horizon has been attributed to the circumstance that when she is low down we can compare her apparent size with that of known objects near the horizon, and seeing that she looks larger than many objects which are known to be really large, as trees, houses, and so forth, we can judge that she is larger than we had (unconsciously) supposed her to be when high up. But I cannot see that there is any force in this explanation. It is true that if the moon when low down is looked at through a tube of any sort, hiding surrounding objects, she no longer appears so large. But this does not prove that the surrounding objects make her look larger, other relations besides those depending on the appearance of surrounding objects are concealed by the tube; and amongst them that which is, I take it, the true explanation of the moon's apparent increase of size.

The fact is that the increase in the apparent size of the moon and other celestial objects as they draw nearer to the horizon is connected with a much wider illusion affecting the apparent dome-shape of the sky over our heads.

Of course when we look at a cloud-laden sky we perceive at once that our range of view is not limited by the interior of a hemispherical surface. The region above our heads seems shaped like the interior of a very much flattened dome, the horizon being much farther away than the sky directly overhead. When the sky is clear the dome above us seems more arched, but it never appears like a true hemisphere. Probably to ordinary eyesight the star-strewn sky on a clear night appears shaped as though the part directly overhead were at only about one-quarter the distance of the part near the horizon. But of course the range of the moon's path around any observer on earth is such that her distance varies very slightly, as if in fact she always moved on the inner surface of a sphere having the observer at its centre. To one then who entertains unconsciously the erroneous notion that the sky is arched over the earth, in such sort that the region overhead lies at about a fourth the distance of the horizon, the expectation unconsciously arises that when the moon is close to the horizon she will present a smaller disc than when she is high up in the sky. As a matter of fact, she looks about as large (not quite, but very nearly), that is she subtends the same visual angle; but the effect of her looking so much larger than had been unconsciously expected, is to suggest that she is really larger than when high above the horizon. We apply to her the same unconscious reasoning by which we recognise that a tree on the horizon which subtends the same apparent angle as a tree close by is much the larger of the two. Having in reality no means of estimating the real size of the moon we make its apparent position guide us to an idea of its size, and as it seems—being near the horizon—much farther away than when high, yet looks no smaller, we judge it to be really larger.

(To be continued.)

TRICKING THE CONDORS.

THE favourite resort of young men in Clyde, N.Y., is a conspicuous long red boat-house, opposite the West Shore Depot. A half-dozen were there last night listening to the stories of Ned Conroy, one of the young men of this place, who has travelled all over the world. He has just returned from South America, bringing considerable money. When asked how he got it, he said:—

"Shooting condors in Chili. The Government pays 5 dols. for every condor's head brought in, but most of the hunters soon get sick of the business. The condors are thicker than buzzards, but they can see a rifle farther than a man can see a house, and they catch on to all

sorts of ambushes in the neighbourhood of a dead carcass almost before they are made. The nests are 12,000 ft. above the level of the sea, so it's little use to hunt them in the mountains. They are trapped occasionally, and some are poisoned, but as a rule the business doesn't pay, and the condors increase in number."

"How do you manage it?" he was asked.

"By playing off sick. Along the coast there are great stretches of sand, without vegetation, which are perilous to cross at all times, because of the heat and the liability of getting lost. It was my plan to start out at night, well provided with water, and seek a place under a big rock, where I could find shelter, and to which I could return by landmarks. At midday I would start out in the broiling sun, walking briskly, and describing a large circle. It was very easy to stagger after awhile and fall and then get up and stagger on again, keeping a good look-out for the birds all the time, lest one should suddenly drop on me from behind. It would take a very short time to bring them swooping around, waiting for the death of what they supposed was a worn-out traveller. Many a poor fellow has fallen down there on these sands and been torn to pieces before he was dead.

"When I found them getting thick I'd back up against a rock and throw stones at them and shout as if I was wild with fear, and the great vultures would gather round just out of range of the stones, which I didn't throw very hard, and sit on the sand, and look at me sideways. Then was my opportunity. Pulling two navy revolvers from under my coat I'd let drive at them. They are wonderful in the air, but to get aloft they must first run along the sand with wings spread for a couple of rods. It was a cold day when I didn't get at least three, and one day I captured seven. That was a trick the condors didn't learn easily."

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

It is a common notion that a dingy sky with a warm temperature constitutes a "blight," though the numerous persons who speak in that manner have no clear idea of what they mean. "How dark it is this morning," says one member of a family, and another more knowing exclaims, "It is a blight!" The proof, or what passes for such, is easy; the young rose-buds, which were clean and flourishing yesterday, now exhibit a swarm of little green insects, and they soon cover up many inches of the stems. Perhaps a cherry-tree that promised a successful ripening of abundance of fruit has all its leaves, especially on the under side, so densely infested with little aphis niggers that the surface cannot be seen. At another time there may be no insects noticeable on the upper surface of the leaves of greenhouse plants, or forest trees, but they are quite sticky with honeydew, and plant-lice of one sort or another will be found underneath. On another occasion the branches of a pear-tree will be coated with brown scales like minute mussel-shells, or an apple-tree may show little tufts of hairy substance like cotton wool, indicating the presence of coccidæ, commonly called bugs.

The so-called "blight" often takes the form of caterpillars, or may be only the effect of a cold dry east wind following quickly upon a warm, moist, south one, and shrivelling up the leaves. If the air is muggy, the mischief may be done by a rapid development of minute fungi belonging to the family of moulds. All these, and many more, attacks upon vegetation are lumped together as "blights"; but although the verb to blight may be justly used to describe the injuries without reference to their causes, it only leads to confusion to talk of "a blight" as if it were one particular disease.

The gardener's most formidable blighting enemies in this country belong chiefly to the insects with sucking mouths, though at times biting caterpillars, or biting beetles are the chief offenders. The farmer's foes are, perhaps, more numerous than the gardener's, and they have been treated by Curtis in his well-known book "Farm Insects," and in Miss Ormerod's more recent investigations.

The very numerous species of plant-lice—aphides and their allies—are all characterised by wonderful powers of multiplication. To start with a dozen is to be on the high road to millions. Each prolific female, whether wingless or winged, rapidly produces offspring, and before the infants are born they contain yet other infants in an earlier stage. For example, we take a cherry-leaf infested with *Mysus ribis*, and carry off one of the black adults on the point of a needle, and place it in a drop of water on a slide. Pressing the abdomen will most likely discharge several infants, some showing the limbs closely folded up, and others in a more advanced stage. Babies rolled up and swaddled, as is still the barbarous custom in many parts of the continent, are not unlike the young plant-lice before their legs and antennæ are free.

From the cherry-tree we may go to the currant-bush and find its leaves deformed with ugly bubbles. These are the work of another aphis, and the creatures abound under the shelter thus obtained. The roses will supply another species, and a search from tree to tree and from herb to herb, wild or cultivated, will be rewarded by the discovery of still different kinds. The wonderfully pains-taking work of Mr. Buckton, "A Monograph of British Aphides" describes and figures well-nigh 140 species of the genus aphis, and other genera add largely to the total number of these plagues found in this country. Happily they have active enemies, or they would soon reduce Great Britain to a desert; but neither birds nor carnivorous insects make any visible impression on the swarms that surround the rose twigs and buds, or that cover the leaves of the currant or cherry. Some recent experiments lead the writer to hope that Sanitas may be found of great service in keeping down their numbers. An ounce of the Sanitas Oil should be shaken up with a wine bottleful of strong solution of the common soda used in washing, and one ounce of this mixture added to one gallon, or two, of water and applied to the plants with a fine rose attached to a watering-pot or syringe. The stronger mixture does not seem to hurt rosebuds or cherry leaves.

The plant-lice (*aphidæ*), scaly bugs, meal bugs, and cotton bugs (*coccidæ*), with other bugs that plague plants, belong to the *Homoptera*. The winged insects of this order have four of these organs, which are altogether membranous, and this distinguishes them from the *Heteroptera* of Westwood's classification, which have the lower part of the anterior wings coriaceous, or leathery. The British representatives of this order are figured and described in Douglas and Scott's work, "British Hemiptera." All the Homopterous and Hemipterous insects, and also the Thrips of all kinds, have mouths constructed upon one principle, and exhibit a projecting rostrum, or snout, containing very fine bristles, representing the man-

dibles and maxillæ of the biting insects. They differ from the sucking mouths of the gnats, because the piercing tools of the latter are like lancets, knives, and saws. The fleas, likewise, have beautiful saws, but the plant plagues we are now considering depend upon the extreme fineness of their setæ, or bristles, and their wonderful strength in proportion to their extreme slenderness. The end of the snouty proboscis is furnished with some sense-organs, and, when a spot is selected for invasion, it is pressed *against* the leaf, but not *into* it, and the fine bristles wriggled in. They not only make a minute hole, but irritate the plant and cause its sap to flow. The coccus family are remarkable for the low condition of their adults. They lose all power of motion, and without careful examination with a magnifying-glass would be taken for dead masses. The Scale-bugs bring up their offspring under the cover of the mother's body. The full-grown mealy-bugs, cotton-bugs, &c., have the same degraded character. The mischief they do is conspicuous enough, but it should be remembered in favour of these creatures, that a Mexican species which feeds upon a cactus gives us cochineal, and others supply the different kinds of lac.

Another set of plant foes which came under the general term of "blights," belong to the *Arachnoideæ* or spider-like creatures consisting of mites and their allies. Any one who has observed a cheese-mite under the microscope will easily recognise most of these creatures. In their adult stage the great majority have the spider's allowance of eight legs, but only six in earlier states. The most tormenting to the gardener is the so-called "Red Spider" that does great harm in melon-beds. The young ones are yellowish, not red, and readily distinguished from the aphides by their greater resemblance to minute spiders. They have sharp pointed snouts. In Andrew Murray's interesting work entitled "Economic Entomology" he gives the figure we copy, and also another from Claparède, showing the snout like that of the Dog Tick furnished with reversed barbs; this I never saw in the Red Spider, though I have examined a good many.

Mites attack the leaves of the lime, the vine, and many others, producing little bubbles, under which they may be found. It would occupy a life to study all the species of these various plant-plagues, but the main characters of the different orders are easily recognised. The aphides puzzle the beginner with their winged females and males, which are quite unlike the wingless females, and usually very beautiful from their large and iridescent organs of flight. Winged specimens early in the season are most likely viviporous females; later they may be males; and for further particulars we must refer the inquirer to Mr. Buckton's admirable work. Dissecting these soft small things is a delicate task, but even rough squeezing in a water-drop will show a good deal, and for creatures which lead inactive lives, except in the matter of feeding themselves, the extent of their tracheal or tube-breathing apparatus is very large. The plentiful aeration is necessary to maintain the activity of the generative process. The tracheal tubes, with their spiral wire to keep them extended, are recognised by their glittering aspect, and require a magnification of 500, or so, linear, to show them well. A beginner should familiarise himself with their aspect in larger insects, or he may miss them altogether in the smaller ones.

The leaves of greenhouse plants, as well as those of fruit and other trees, are often found spotted over with the sweet tenacious fluid called honeydew. This sticky substance stops up their pores, and produces much damage. It is certainly known to be produced by aphides, but whether all that is found has that origin, or some is simply an exudation from the plants, is still in dispute, though the aphis origin is the most probable. The aphides usually occupy the under surface of leaves, and from that position they may easily drop the fluid on the upper side of the leaves below them. But leaves are frequently found in a great mess from abundance of the honeydew when there are no others above them; and this leads to the opinion that the plants have exuded it in consequence of some disease. When it first appears, however, no symptom of such disease is recognisable,

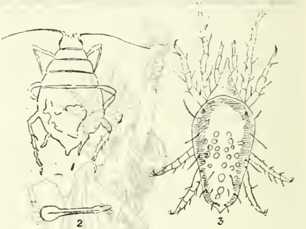


Fig. 1. *Mysus ribis*, outlined after Buckton. The insect is quite black.

Fig. 2. Its rostrum. The fine bristles are in the middle, and can be protruded a considerable length when required.

Fig. 3. *Tetranychus telarius*, or Red Spider, as given by Murray from Claparède.

but the leaves soon become sickly and the sweet stuff is favourable to the growth of that greenhouse pest, the black fungus, *Fumago varians*. Mr. Buckton inclines to the aphis origin of honeydew, and observes: "Even when no aphides are feeding above, myriads of the winged forms often fill the air on a hot summer's day, and void their juices while on the wing, just as we see in some of the lepidoptera." The sugar in honeydew has been identified by Boussaingault as of the cane sort. Bees do not take any notice of it so far as my observations go, although it may be plentiful close by the flowers they frequent.

COLOSSAL SCULPTURE.*

By M. Bartholdi.

I THINK that it may be timely to examine briefly the characteristics of colossal statuary, in view of the fact that the art has from time to time been the object of criticism. Many persons see in it only a striking production, and do not understand its peculiar laws, its difficulties, nor its artistic value.

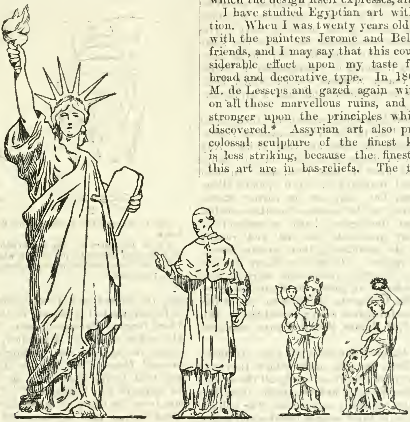
Colossal statuary does not consist simply in making an enormous statue. It ought to produce an emotion in the breast of the spectator, not because of its volume, but because its size is in keeping with the idea that it interprets and with the place which it ought to occupy. It should be used only in dealing with a limited order of ideas. M. Lesbazeilles, in his work on the Colossi has

* From the *New York Tribune.*

said with reason: "It is within its scope when it represents power, majesty, infinity. It can lay claim to that class of effects which are produced in us by the heaving of the boundless sea, the bellowing of the wind, the rolling of the thunder."

Also M. Charles Blanc, the celebrated art critic, says on the same subject:—

Colossal statuary calls for faculties of peculiar power. It is an art of an exceptional character, which presents considerable difficulties. The artist who approaches these difficulties enters a sombre temple, peopled with mysteries. He is brought face to face with struggles which few artists have experienced. No one can advise him, nothing can guide him except his instinct, his faith, and his courage. Conception and execution are controlled by rigid and difficult laws. Faults once committed can be hidden by no subterfuge, and if the artist fails the depth of his fall is commensurate with the immensity of his aspirations. Instead of producing many works in which he may attain success in a variety of ways, he exhausts a large part of his life upon a single task, on which he pours out all his treasures of passion, of study, and of enthusiasm. With these he must without pause keep up his ardour during long years.—[Charles Blanc in *Le Temps*.



Comparative height of the great Colossal Statues without their pedestals. Statue of Liberty, 46·08 mètres; St. Charles Borromeo, 22 mètres; Virgin of Puy, 16 mètres; Bavaria, 15·70 mètres.

These words seem to me to answer in a large measure the criticisms of which colossal art is sometimes the object.

Without wishing to make a detailed study of the colossal statues which have been produced, I think that it might be interesting to the reader to recall rapidly the most remarkable works of this kind of past times. Egypt incontestably gives us on this point the most complete instruction, and we can judge Egyptian colossal art with our own eyes.

To all those who have studied it, Egyptian art has been the object of profound admiration, not only in view of the masses, the millions of kilogrammes moved by the Egyptian people, but on account of its concrete and majestic character, in design and in form, of the works which we see. We are filled with profound emotion in presence of these colossal witnesses, centuries old, of a past that to us is almost infinite, at whose feet so many generations, so many million existences, so many human glories, have rolled in the dust. These granite beings, in their imperturbable majesty, seem to be still listening to the most remote antiquity. Their kindly and impassable glance seems to ignore the present and to be fixed upon an unlimited future. These impressions are not the result simply of a beautiful spectacle, nor of the poetry of historic remembrances. They result from the character of the form and the expression of the work in which the design itself expresses, after a fashion, infinity.

I have studied Egyptian art with the greatest attention. When I was twenty years old I travelled in Egypt with the painters Jerome and Belly, and several other friends, and I may say that this country had a very considerable effect upon my taste for sculpture of the broad and decorative type. In 1868 I went back with M. de Lesseps and gazed again with the same pleasure on all those marvellous ruins, and my convictions grew stronger upon the principles which are there to be discovered.* Assyrian art also presents specimens of colossal sculpture of the finest kind, only its effect is less striking, because the finest remaining types of this art are in bas-reliefs. The taste for colossal art certainly made its way into Greece along with many other artistic traditions which came from Assyria, as well as from Egypt. Archæologists have often asserted this relationship. Phidias executed two colossal statues, in which he succeeded in uniting material grandeur with a true ideal of beauty of form. The statue of Minerva in the Parthenon measured thirty-seven feet, and that of the Olympian Jove forty feet. They have both been regarded

* At this period I was expecting to execute a statue of Egypt for the Suez Lighthouse. I even laid before Ismail Pasha a project. It was this that made an evil-disposed newspaper say, and others repeat, that I had executed a colossal statue for Egypt, which had not been used, and that I had resold it to the Society of the French-American Union, in order that from it might be made the Statue of Liberty. Now, I never executed anything for the Khedive except a little sketch which has remained in his palace, and which represents Egypt under the features of a female Fellah. Besides, every one has seen the model of the Statue of Liberty made at Paris, and only evil-disposed persons are ignorant of what it has cost me. I have never answered these small cavillings, but I think that I ought to notice them on this occasion.

as masterpieces of chrys-elephantine sculpture (otherwise called sculpture in gold and ivory). All the ancient authors, Pausanias, Pliny, Quintilian, have spoken of them with much enthusiasm, and in terms which leave no doubt of the value of those works and of the profound impression which they produced on the Grecian world. The other admired works of that period which have come down to us permit us to consider them good judges.

The most celebrated colossal statue of antiquity was the Colossus of Rhodes. We may consider it as having been a very remarkable piece of work, independently of the fantastic legend of the ships which passed between its outspread legs. This legend, whose origin is not older than the sixteenth century, has been exploded by archæologists; nevertheless we may add to their observations a demonstration founded on simple good sense. First, if the Colossus was placed with its legs apart above the water, when it was overthrown it would have fallen into the water, and the enormous fragments, resembling caverns, of which Pliny speaks, would not have been gotten out, leaving within the stones, themselves enormous, which he says he saw there; second, the result of my personal studies shows that the placing of a statue of this kind in an upright position would be almost impossible, but that it would be absolutely so if stones were placed in the body, which would result in bringing the centre of gravity too high.

After the Grecian epoch we must pass on to modern times to find examples of colossal statues. The Jupiter Pluvius of the Pratolino Villa, executed by John of Bologna, and the St. Charles Borromeo on the Banks of Lake Maggiore, may be referred to. It cannot be said that this last work is properly included under the head of colossal art. It is an ordinary statue enlarged, and its volume gives it its principal interest. The pedestal is deplorable, and nothing in the whole work shows either research into the principles of colossal art or a comprehension of them. Nevertheless, this work of art has a peculiar interest in virtue of its material execution. It is, I think, the first example of the use of *répoussé* copper mounted on iron trusses. In ancient times metal beaten out into sheets had already been used. But it was used as a covering or was modelled on a solid form of wood or stone. Gold, silver, and copper were thus employed in Grecian antiquity and in the extreme Orient. The statue of St. Charles Borromeo is the first known example of a statue of *répoussé* copper, worked with the hammer on the inside and outside, and freely supported on iron beams. The work was executed in a somewhat coarse style, but it is interesting, and has the merit of being the result of a bold initiative. The copper is a little thin, measuring only a millimètre in thickness, and yet the whole work has stood until to-day—that is to say, for two centuries.

All the other colossal statues in existence are entirely modern. That of Bavaria is the oldest. It measures 15·70 mètres. Next was executed the colossal statue of the Virgin of Puy, which is 16 mètres in height; and, finally, that of Arminius, in Westphalia, which, including the sword which he raises towards the sky, is 28·30 mètres in height.

The object of this review of the colossal statues which have been produced up to the present time is to bring back their image to our eyes, and to enable us to deduce from them some principles which seem to be essential in colossal art. The understanding of these principles and their interpretation may vary somewhat, according to the sentiments of the artist. Yet some of them seem to me to manifest themselves in a way which admits of no discussion. They are to be found: First, in the character or the thought of the subject, which ought to be in harmony with the size of the work; secondly, in the suitableness of the site and the surroundings of the monument; thirdly, in the understanding of the lines and the make-up which in colossal works of art are rendered necessary by the execution. On the first point I will recall the words of M. Lesbazeilles, which I cited above, when he says that colossal statuary ought to be used only to symbolise figures or thoughts which are grand in themselves, and as far as possible abstract. The immensity of form should be filled with the immensity of thought, and the spectator, at the sight of the great proportions of the work, should be impressed before all things else, with the greatness of the idea of which these ample forms are the envelope, without being obliged to have recourse to comparative measurements in order to feel himself moved.

In regard to the choice of site, a study should be made of similar existing works in order clearly to perceive the most favourable conditions. The frame should lend itself to the subject. It may be made up or improved by architectural effects, by the flights of stairs which lead up to the statue and contribute to the monumental character, but above all, a site favourable by its own nature should be sought. There is an instinct which ought to guide the artist, for he ought to turn Nature to account in such a way as to make her contribute to the aspect of the monument. The neighbourhood of large masses should be avoided. The artist ought to choose his site in such a way that the lines of the ground and the colouring of the background will become his assistants in heightening the proper appearance of his work and the impression which it is to produce.

In regard to the execution of colossal works of art, I think, as I said above, that we find sure principles in the ancient works. The difficulty is to apply them to one's own age—that is to say, without servile imitation of the forms imagined by other epochs and other races.

I may cite, for example, the principle of great simplicity in the movement and in the exterior lines. The gesture ought to be made plain by the profile to all the senses. The details of the lines ought not to arrest the eye. The breaks in the lines should be bold, and such as are suggested by the general design. Beside, the work should be as far as possible filled out, and should not present black spots or exaggerated recesses. The surfaces should be broad and simple, defined by a bold and clear design, accentuated in the important places. The enlargement of the details or their multiplicity is to be feared. By exaggerating the forms in order to render them more clearly visible, or by enriching them with details, we would destroy the proportion of the work. Finally, the model, like the design, should have a summarised character, such as one would give to a rapid sketch. Only it is necessary that this character should be the product of volition and study, and that the artist, concentrating his knowledge, should find the form and the line in its greatest simplicity.

These same principles ought to be kept in mind in the construction of the pedestal, for they exist in architecture. I could, if I were not afraid of being prolix, cite examples of remarkable edifices, in which the enlargement of certain details or the lack of simplicity in the lines prevents the spectator from appreciating at first sight the monumental proportions of the edifice.

These are subjects on which there might be much said. I thought that it would be well to touch lightly upon them, not with the pretension of laying down

principles, but to show the thoughts which animated me, the artistic considerations and the ideals by which I have sought to be guided in my work.

(*To be continued.*)

Gossip.

BY RICHARD A. PROCTOR.

THE "Glorious Fourth" of July, or Independence Day, has just been celebrated throughout the United States in the customary manner,—that is, like a magnified Guy Fawkes' Day. The number of fires caused by accidents with fireworks has been rather below the usual average—not more, in fact, than eighty have been announced up to the moment of my writing this. For the whole Union this is not so bad. Personal accidents have, of course, been much more numerous; but then the chances are that most of the injured belong to the more foolish sort in the community. If we imagine an accident to every Guy Fawkes' crew on November 5th next, we can see that the loss would not be great even though many of the accidents were serious. This would certainly be the case if only grown persons—engaged in Guy Fawkes nonsense—suffered: for a man must necessarily be an idiot who takes part in such proceedings. In America grown rowdies take so large a share in Fourth of July displays, that the more sensible part of the community are tempted to positively pray for accidents.

OF course an Englishman is bound to be gratified by the earnestness of Americans in celebrating the establishment of American Independence—the last work of the purely British people in the original 13 provinces. So the achievement may fairly be described, for the men who wrote and signed the Declaration of Independence, those who accepted it, and those also who fought and bled for it, were British until the work was done, and therefore the accomplished work was a British achievement, the greatest gift the English-speaking race has made the world—one may even say, the greatest gift ever made to the nations.

POSSIBLY not every one in America on Saturday, the 4th of July last, viewed the matter precisely in this way. There are so many persons of German, Swedish, French, and other foreign blood in the United States, so small a proportion of the people can claim descent from those who established independence here, that probably a good deal of ignorance prevails in America as to the history of the struggle for independence. I find, indeed, that many imagine, or speak and write as if they imagined, that it was the present mixed population of America which fought and bled for independence a century and more ago,—and not the British inhabitants of the thirteen British American provinces. They talk, strange to say, of "us Americans whipping you Britishers," not knowing (it would seem) that the real struggle was between Britons who had settled in America, and Britons who had remained in the old country. There was no America in the modern sense of the name, before the Glorious Fourth.

THE Town Councillors of Hamburg have adopted without debate the proposal to allow cremation in place of burial.

Reviews.

SOME BOOKS ON OUR TABLE.

On Light as a Means of Investigation. By GEORGE GABRIEL STOKES, M.A., F.R.S. (London: MacMillan & Co. 1885.)—This is a reprint of the second series of discourses on light, delivered (as "Burnett Lectures") in Aberdeen last December, by Professor Stokes, and deals with light as a mode of investigating the molecular structure of bodies, their chemical constitution, the intimate structure of the sun and comets, and celestial motions of approach and recession. It is superfluous to add, what, in fact, is guaranteed by the mere name of their author, that these lectures are at once lucid and accurate. The young astronomer will find much to interest him in the account of spectroscopic research, and the knowledge with which it has supplied us of the nature of nebulæ, comets, our own sun, and those others which we call the fixed stars; in fact, Professor Stokes's little volume should be upon the shelves of every student of physical science.

Shall we Hang the Insane who Commit Homicides? By CLARK BELL. Reprinted from the *Medico-Legal Journal*, New York.—Mr. Clark Bell is apparently severely exercised in his mind about the hanging of a certain Dr. Beach on Feb. 12 last, at Holidaysburgh, in Pennsylvania, U.S., for the trivial offence of murdering his wife by nearly severing her head from her body. Dr. Beach may—or may not—have exhibited symptoms of eccentricity, numerous witnesses, however, testifying to his perfect sanity; but, of course, the question for the jury really to decide was: when this man committed the murder, did he, or did he not, know that he was doing wrong? It is time that a stop was put to the vagaries of the fussy and noisy clique of mad doctors (we beg their pardon, "Alienists" is the last designation they have coined for themselves). Happily now in England we have at last got a Home Secretary possessing a fair share of common sense, and sufficient independence not to be "squeezed" or to truckle to external opinion in this and cognate matters.

The Mersey Tunnel; its Geological Aspects and Results. By T. MELLARD READE, C.E., F.G.S. (Liverpool: C Tinling & Co. 1885.)—Twelve years ago Mr. Mellard Reade enunciated the theory that the rocky bed of the Mersey between Warrington and Liverpool was a river valley, and that there was a deep depression or gulley in the river between Birkenhead and Liverpool filled with drift. Now that the Mersey Tunnel works have revealed the existence of this pre-glacial valley and the depression whose existence he affirmed, he exhibits, not wholly unnaturally, no little gratification at so literal a fulfilment of a prediction founded on theoretical grounds; and it is to a somewhat detailed account of the nature and stratification of the deposits intersected that his pamphlet is devoted. It will repay perusal by all interested in the geology of the neighbourhood.

The First Three Years of Childhood. By BERNARD PEREZ. Edited and Translated by ALICE M. CHRISTIE, with an Introduction by JAMES SULLY, M.A. (London. W. Swan Sonnenschein & Co. 1885.)—M. Perez has given us a work of exceptional interest, alike to the psychologist, the evolutionist, the parent, and even the general reader. Obviously passionately fond of children and animals, he has arrived at his facts strictly by observation and experiment, with the result that he has made a contribution of real and enduring value to the science of

infant psychology. Every reader of the volume before us (which means, we are persuaded, every one who ever opens it) will find his (or her) interest and attention so secured and stimulated that he (or she) will almost certainly attempt to repeat the observations so delightfully recorded by our author. His book is crowded with illustrative anecdotes of his pets and protégés; and his comparison of the intellectual development of the human infant with that of the young of other animals is at once most suggestive and instructive. In his excellent introduction Mr. Sully points out the advantage which must accrue to science by multiplied observations of the character so pleasantly recorded by M. Perez; and expresses a hope that the work of the able Frenchman may stimulate individual research in the same field on this side of the Channel. He goes on to add that there is an English journal of psychology whose editor "has proved his readiness to publish contributions to the young and promising science of baby-lore." Verbum sat sapienti.

The Black Forest: Its People and Legends. By L. G. SÉGUIN. Third Edition. (London: Hodder & Stoughton. 1885.)—The reader who, after the perusal of Miss Séguin's charmingly chatty volume, can resist making the Black Forest the scene of his very next holiday tour, must either be adamant against temptation, or must be wholly wanting in the pecuniary means for making the journey thither. For it would be difficult to find a guide-book which better justifies its *raison d'être* than hers; and her descriptions of the grand and romantic scenery, of the manners and customs of the primitive people who live amid it, and notably her way of relating the many legends so rife where the teachings of the Royal Institution are as yet unknown as the Vedas, being in their way models of what they should be. Six clearly-printed maps and thirty-four engravings of scenery illustrate the text. To those, then, who are seeking for some change from the beaten track of the ordinary continental tourist, we would commend the study of the volume whose title heads this notice. Our authoress assures them that in the birthplace of the cuckoo-clock and the musical-box, they will meet with the simplicity which pertains to all such primitive people as are yet untouched by modern civilisation; and that in the unpretentious inns which will form their abiding-places they will find hospitality, brilliant cleanliness, honesty, and low charges—qualities not invariably and inseparably united in the bigger hotels of more familiar European cities.

Results of Rain and River Observations made in New South Wales during 1884. H. C. RUSSELL, B.A. (Sydney: Thos. Richards. 1885.) Within the sixty-one pages of Mr. Russell's volume is comprised a mass of statistics of very considerable interest to the meteorologist and hydrologist. Messrs. Balfour Stewart and W. L. Carpenter may (or possibly may not) be glad to learn that of a year of maximum sun-spots, we find the Government Astronomer of New South Wales writing: "Judged by its mean rain-fall, 1884 must be counted a very dry year, the rainfall record for the whole colony being, as we have seen, some 30 per cent. short of the average."

Comets, Indications of Ring Structure. By GEORGE ST. CLAIR, F.G.S. (Reprinted from the Proceedings of the Birmingham Philosophical Society. Vol. IV. Part II.—Mr. Sinclair has expended a good deal of ingenuity in an attempt to show that a comet consists of a mass of meteoric stones revolving in a series of shells round a central nucleus, and that by solar action these shells are pulled out into very elongated ellipses, with their major axes, or lines of apsides, passing through the nucleus and the sun. He cites the Saturnian ring system in illustration of his hypothesis, and adduces it to explain many of the curious phenomena so familiar to all who have studied comets telescopically. But he himself speaks of "the extremity of the tail—fifty or a hundred millions of miles from the head"; and one would be curious to see his dynamical proof of the possibility that any such nucleus as has yet been observed could exercise gravitating power over an aggregation of matter which, if his hypothesis be correct, must be *indefinitely heavier than itself!* The mass of Saturn's ring system (as determined by Tisserand, in 1877) is only ·0016 that of the planet: but with the condition of things reversed, we should, with Mr. St. Clair's hypothetical comet, get into the condition of Lord Dundreary's dog, of whom that lamented nobleman remarked that, "if he didn't wag hith tail, hith tail would wag him!" We fear that this fresh hypothesis will have to go to that bourne whence Professor Tait's quoted one will never return.

Scientific Romances. No. 2: "The Persian King, or the Law of the Valley." By C. H. HINTON, B.A. (London: Swan Sonnenschein & Co. 1885.)—Mr. Hinton was so very good in the first of his "Scientific Romances" (which we reviewed on p. 510 of our Sixth Volume) that he suffers a little by comparison with himself in the second one now before us. Under the allegory of a king who brings a great empire into existence, our author expounds the doctrine of energy in a manner perhaps better calculated to convey sound notions on the subject to the general reader than it has heretofore been presented in. We say advisedly the general reader, because to the student of science a little more advanced, books are open which deal perspicuously and in detail with that doctrine. But this second little volume needs harder thinking and more watchful perusal than the first one did to enable its drift to be apprehended. Both the mathematician and the experimental physicist will find a very subtle hypothesis as to the real nature and meaning of the conservation of energy developed in the concluding chapters.

Bright Days. Holiday Number of *Cassell's Magazine.* (London: Cassell & Co.) Here is a charmingly illustrated and readable book, to be enjoyed under the shade of a spreading tree or on the beach to the accompaniment of the plash of the waves. Nine stories, as many articles, and a few notes make up the number, which will surely be seen in many a railway-carriage and on many a steamer's deck during the forthcoming holiday season.

Leaves from the Note-book of THOS. ALLEN REED. Vol. II. (London: F. Pitman. 1885.)—This is a continuation of the history of Mr. Reed's reporting experiences, the first volume of which we noticed on p. 346 of our own sixth one. As in that case, the work is given throughout in the characters of reporting phonography, a printed key in ordinary type appearing at the bottom of every page. This book possesses a certain value for the student of stenography, inasmuch as there are, perhaps, not half-a-dozen dry pages in the whole volume, and the pleasure of rendering an amusing story into shorthand or of reading it in that form is of necessity much greater than that afforded by the reproduction of a mere string of disconnected sentences. All who aspire to become reporters should buy it and its predecessor.

How to be a Successful Amateur Photographer. By W. J. LANCASTER, F.C.S. (Birmingham: J. Lancaster & Son.)—Those who read the favourable notice of Mr. Lancaster's capital little manual on p. 204 of our last volume will not be surprised to learn that it has already run into its tenth thousand.

THE FACE OF THE SKY.

FROM JULY 31 TO AUGUST 14.

BY "F.R.A.S."

THE usual watch for spots and faculæ on the sun will be kept on every clear day. Map VIII. of "The Stars in their Seasons" exhibits the aspect of the sky after dark. Mercury is an evening star during the next fourteen days, and may be picked up after sunset close to the Western horizon. He is at his greatest Eastern elongation (27° 21′) from the sun at 3 a.m. on August 6. In the telescope he is becoming crescentic. Venus is an evening star too, and is a much more conspicuous object than Mercury in the same region of the heavens. She presents a small brilliant gibbous disc in the telescope. She is in conjunction with Mercury at 5 p.m. on the 8th, and is 3° 42′ North of him. The actual night sky so far as the other planets are concerned is now a blank, the whole of them being more or less in the neighbourhood of the Sun. The Moon enters her last quarter at 9h. 55·3m. p.m. on August 3, and is new fourteen minutes after noon on the 10th. No occultations happen within our prescribed hours during the period these notes cover. When they begin the Moon is in Pisces, which she quits for the extreme N.W. corner of Cetus at 10 p.m. on the 2nd, after travelling through which for eleven hours she emerges in Aries the next morning. At 2 p.m. on the 4th she leaves Aries and enters Taurus, her passage through which occupies until 1h. 30m. a.m. on the 7th, at which last-named hour she passes the boundary of the northern part of Orion. It takes her until 1 o'clock in the afternoon of the 7th to cross this, and then she enters Gemini. At 1 a.m. on the 9th she enters Cancer; which, at 11 a.m. on the 10th, she leaves in turn for Leo. In her passage through Leo she, at 6 p.m. on the 11th, descends into Sextans, re-emerging, however, in Leo five hours and a half afterwards. At 10 p.m. on the 12th she finally quits Leo for Virgo; across which great constellation she is still travelling when our notes terminate.

Miscellanea.

IN consequence of the enormous stock of beetroot sugar on the Continent, the East and West India Dock Company lost in the first half of the year no less than 22,000 tons of sugar-laden vessels from the West Indies as compared with the previous year.

A REUTER'S telegram dated Rome, July 23, says that during a violent thunderstorm at Torre Cajetani, a small market town in the neighbourhood of Anagni, thirteen persons were killed and twenty-two severely injured by the lightning.

WE understand that Mr. Alexander Watt has been for many months engaged in writing a comprehensive practical treatise on the "Electro-deposition of Metals," including the electrolytic refining of copper and other metals and treatment of ores. The work, being now complete, will shortly be in the hands of the public. The publishers will be Messrs. Crosby Lockwood & Co.

A BIG BLAST.—A mass of granite estimated to weigh at least 500,000 tons was displaced recently on the line of the Iron Mountain Railroad, Missouri, by a single blast. A shaft 65 ft. deep was sunk, with lateral chambers in which five tons of powder were stored. After the shaft had been nearly filled to the top, an electric spark from a battery a half mile distant fired the magazine with the result indicated.

IT is said that there is a fair prospect that the works for the improvement of the Danube waterway will at last be undertaken. The commission of experts appointed to examine the means of removing the obstructions at the Iron Gates is nearly ready with its report, and meanwhile the Hungarian Government has granted 1,500,000fl. for dredging operations on the Hungarian part of the Danube. This money is to be recouped by tolls on shipping.

THE *National Car Builder* says:—"The Boston and Maine road has a new parlour car called the Magnolia. It is 60 ft. long, and is finished inside with mahogany. There are seventeen windows on a side. The seating consists of forty luxurious chairs upholstered in leather, each of which is numbered. It is proposed to sell them to the patrons of the road at 30 dols. per chair for the season of four months, an arrangement that proved very popular last year."

THE German Government are having a boring made near Schladebach for the purpose of determining the increase of the earth's temperature. The depth reached is more than 1,392 mètres, the lowest depth yet obtained by boring. The temperature at successive depths is ascertained by a new mercurial thermometer of most ingenious construction. It has been determined that the temperature at the depth of 1,392 mètres was 49° C., or 120° Fahr. At this rate of increase the boiling-point of water should be reached at a depth of 3,000 mètres.

THE coalfields of Russia are, Mr. W. Mather says, still practically undeveloped. The Donetz coalfield is too remote for the manufacturing districts, and the railroad communications are too uncertain to admit of its being largely used. The lignite found within a radius of 200 miles of Moscow does not offer fuel of a sufficiently good quality. It is a remarkable fact that during the past two years English coal has been found to be the most profitable fuel that manufacturers could use immediately around Moscow at a price laid down of about 40s. per ton. Twenty years ago the price of wood fuel was so low as to be equivalent to coal at 10s. per ton, and now coal at 40s. per ton is cheaper fuel. This is apparently a consequence of the reckless destruction of forests in Russia without systematic planting under Government supervision. —*The Engineer.*

IN the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, M. Carnot, in a report presented by him on behalf of the Committee of Chemical Arts, showed that the cause of the corrosion of sheet copper employed for the sheathing of ships is the presence of cuprous oxide, which, in contact with salt water, occasioned the formation of soluble salts, even when the air is excluded. In order to reduce more completely the oxygen compounds present in the copper, he introduces a small quantity of metallic manganese, which completely reduces the cuprous oxide remaining in the metal, and becomes converted into a manganese silicate, in contact with the sides and the sole of the furnace. If a few thousandths of manganese remain alloyed with the copper, they affect neither its malleability nor its resistance to the action of sea water. The manganese is introduced in the form of cupro-manganese, an alloy containing 75 per cent. of copper and 25 of manganese.

PRIZE AWARDED TO DR. BROWN-SÉQUARD.—It is the custom of the five Academies constituting the Institute of France to award a prize of 20,000 francs every two years. The prize is successively given to a scientist, a man of letters, a philosopher, an artist, and an archæologist. Every second year one of the five Academies selects a candidate, and, with the consent of the other bodies forming the Institute, awards him the prize—a prize, be it remembered, that such men as M. Guizot and M. Thiers were proud to obtain. The Académie des Sciences selected Dr. Brown-Séquard for the prize, and the Institute ratified the choice by a majority of sixty-seven votes, the numbers being seventy-four and seven. It must be a source of much gratification to Dr. Brown-Séquard to find that his efforts to extend our knowledge of physiology and pathology have been so ungrudgingly appreciated by the Académie des Sciences, as well as by the whole Institute of France.—*Lancet.*

IN the following figures are given, first, the sea-going merchant fleets of all nations, and, second, the steamships of all nations:—Great Britain, 22,500 vessels, 11,200,000 tons; United States, 6,600 vessels, 2,700,000 tons; Norway, 4,200 vessels, 1,500,000 tons; Germany, 3,000 vessels, 1,400,000 tons; France, 2,900 vessels, 1,100,000 tons; Italy, 3,200 vessels, 1,000,000 tons; Russia, 2,300 vessels, 600,000 tons; all nations, 46,000 vessels, 23,000,000 tons. Thus it will be seen at a glance how tremendously England outrivals every other marine Power. Her preponderance is even greater in steam vessels, as appears by this second statement:—All nations, 7,764 steam vessels, 9,232,000 tons; Great Britain, 4,649 steam vessels, 5,919,000 tons; France, 458 steam vessels, 667,000 tons; United States, 422 steam vessels, 601,000 tons; Germany, 420 steam vessels, 476,000 tons; Spain, 282 steam vessels, 305,000 tons; Italy, 135 steam vessels, 166,000 tons; Holland, 127 steam vessels, 155,000 tons; Russia, 194 steam vessels, 149,000 tons.—*The Engineer.*

THE employment of natural gas as a fuel by manufacturing concerns may, remarks the American *Railway Review*, mean more to our industrial interests than has been generally anticipated. "Great sums of money have been invested in changed plant by many heavy houses who figure upon material profits through the use of the novel fuel. Despite the dangers which the timid ascribe to its use, and the lack of absolute certainty as to permanence of supply, the heavy capitalists of Pittsburgh have enough faith to warrant these large expenditures. Some of the anticipated results in the way of savings have already made themselves felt. For instance, it is estimated by good judges that there are already 3,000 tons less of coal burned in Pittsburgh per day than there were before natural gas was used. This takes away a coal business of 2,500,000 dols. or more a year. One concern saves 100 dols. a day in wages formerly paid to men who wheeled out ashes. The decrease of smoke in the atmosphere is already noticeable."

TO CORRESPONDENTS

"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office,* 74, *Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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THE RUDDY ECLIPSED MOON.

[1839]—Referring to Mr. Proctor's papers on this subject, I still fail to understand how the "very own sun" can be *all* refracted and *all* be brought round and above the earth's horizon, and *all* thus seen from the moon, as shown in his diagram, spots and all, without radiating to the moon his normal amount of luminous and calorific energy, minus, of course, that intercepted by our atmosphere. The sun being thus optically removed from behind the earth, there would be no more solid earth shadow thrown upon the moon than upon a terrestrial object when we see the sun just above our horizon. If Mr. Proctor is right the accepted explanation of lunar eclipse, as due to the shadow of the earth falling on the moon, is all wrong. If *no part* of the sun is optically behind the earth (from the lunar standpoint) it can cast no shadow, nor even penumbra upon the moon.

My version of the accepted explanation is that given by Sir John Herschel, who ("Outlines of Astronomy," section 424) ascribes the ruddy hue of the moon to the twilight glow of our atmosphere, the lowermost strata of which, he says, "impart to all the rays they transmit the ruddy hue of sunset, only of double the depth of tint which we admire in our glowing sunsets, by reason of the rays having to traverse twice as great a thickness of atmosphere." I quoted these words, and maintained (I do so still) that, according to the explanation they expound, the moon should have been excessively ruddy on Oct. 4 last, when "the ruddy hue of sunset" was excessive.

I see now by Mr. Proctor's paper of July 17, page 46, col. 1, that he has come to the same conclusion as mine in the *Gentleman's Magazine* of November, 1844, where I said that "if the atmosphere is greedily appropriating the red rays which reach it from without, and using them for colouring itself by internal reflection or scattering," its transmission of such rays will be proportionally impeded. Here Mr. Proctor, evidently without knowing it, is controverting the accepted theory as expressed by Sir John Herschel, and confirming my exposition of one part of the subject.

On page 45, Mr. Proctor asks whether I have ever tried the experiment of heating a tufaceous surface to redness. My reply is that I have witnessed the experiment (of my own and others making) many thousands of times. When engaged as chemist to one of our largest iron works, I had continually before me puddling furnaces, reheating furnaces, steel melting furnaces, regenerative furnaces, &c., the efficiency of every one depending on the remarkable facility with which a tufaceous surface such as that of ganister, fire-clay, "bull-dog," &c., absorbs radiant heat, becomes red hot, yellow hot, or white hot thereby, and at the same moment, and with corresponding facility, re-radiates this heat on the steel or iron to be fused or welded.

Every reader of KNOWLEDGE has seen the same, on a smaller scale, every time he has turned his eyes towards an ordinary English fireplace lined with fire-clay. The most instructive are those ill-constructed examples where the back is tufaceous and the sides metallic. There, the radiations from the same burning coals make the tufa red hot while the iron remains black.

As to "the exceedingly rapid radiation" which Mr. Proctor seems to suppose refutes my idea of the heating of the lunar surface, he surely understands that such radiation is the correlative of absorption. The exceedingly rapid radiation proves a corresponding rapidity of absorption, and the active absorption which I claim for the tufaceous surface assumes, as a matter of course, the active radiation. The law of "exchanges"—one of the broadest and soundest generalisations of physical science—teaches us that when two radiating bodies are opposed to each other, both absorb and both radiate, but that, *cæteris paribus*, the absorption will vary inversely, and the radiation directly, with their respective temperatures, and thus, as Clerk Maxwell says, "heat will be lost by the hotter and gained by the colder bodies till thermal equilibrium is attained."

As Mr. Proctor still fails to understand the basis of my estimation of lunar surface temperature, I must surely have failed to make it generally intelligible, and will therefore state the numerical elements of the problem, but in doing so will take the figures of those who, like Mr. Proctor, deny the extension of ordinary atmospheric matter throughout space. The temperature of space, according to these is $-273\frac{1}{3}°$ C. or $-459{\cdot}13°$ Fahr. (I estimate it many degrees higher, but this goes against myself, as will be presently seen). Therefore all the difference between this and our terrestrial temperatures (neglecting stellar radiation) is due to solar radiations. Under a tropical sun at sea level a spherical body with a tufaceous surface (represented by the blackened bulb of a thermometer) rises when exposed to the sun to 150° or 180° Fahr., and even higher in the course of a terrestrial day. (On Saturday last the sunshine thermometer at Greenwich reached 155·5°. On Monday, 161·3°; the highest in the shade, 87°.) Taking the lowest figure, the total heat received is $459+150=609°$. According to some authorities our atmosphere arrests one-third of the solar radiations. Others estimate double as much. Calling it one-half the absolute temperature of a spherical tufaceous surface if exposed freely to the sun without atmosphere obstruction, as at the moon, would thus be 1218°; or $1218-459=759°$ Fahr., *i.e.* 159° higher than my original estimate of 600°. This when only exposed for the period of terrestial daylight. I need not here discuss the question of how much the temperature would be augmented by the greater period of lunar exposure, though I have considered the effect of this, and may find occasion to explain it hereafter. At present I studiously limit myself to accepted figures, but as the lawyers say "without prejudice."

I have little doubt that my present heresy concerning the temperature of the moon will, in due course, share the fate of a closely resembling heresy which I perpetrated about seventeen years ago, and published in "The Fuel of the Sun"—viz., that of concluding on the basis of purely physical data that Jupiter, Saturn, Uranus, and Neptune are incandescent gaseous orbs like the sun, and enveloped in an atmosphere of cloud matter. Mr. Proctor and others have accepted this, as they will presently accept my red-hot moon.

As regards this same "Fuel of the Sun," 19–20ths of which Mr. Proctor says is out of the pale of science, I may add that in this conclusion he *now* stands nearly alone *among those who have read it.* Sir Charles Lyell, Sir William Grove, Sterry Hunt, and many others have estimated it very differently. Sir Charles Lyell was very earnest concerning it, making his friends promise to read it all through. He knew, as I knew well enough when I published it, that a book of such pretensions, written by an unofficial theorist, would not be looked at by the average scientific official, who is too wise (in his own conceit) to be instructed by an outsider.

An amusing example of this prejudice was afforded by a well-known writer, and one who swears by Sir Isaac Newton, who refused to look at the book on account of its "sensational title." Presently an old forgotten essay, by Sir Isaac Newton himself, is unearthed by Sterry Hunt, in which my sensational title is used by this great authority, and not only this, but my fundamental heresy—that of the universal diffusion of atmospheric matter—is propounded by Newton; and worse still, the primary idea which the whole of the twenty-twentieths of the book is devoted to working out was prophetically suggested by Sir Isaac Newton as that which should be thus worked out in solving the great mystery of the "solary fuel."

I thus lose some of my claim for novelty, though none for originality. This loss is more than compensated by such flattering evidence of intellectual sympathy with so great a man, to whom I am thereby impelled to say, as Jack Falstaff said to Prince Hal, "I shall think better of myself and thee during my life."

W. MATTIEU WILLIAMS.

EVOLUTION.

[1840]—It is difficult to make out what "Commentator" really means. His numerous letters, which would almost require a commentary written on them to be properly understood, have a strong flavour of mysticism and quite a theological odour. *Timeo Danaos!* Overlooking apparent inconsistencies and inaccuracies, the letters appear especially to involve misconceptions as to the nature of

cause and the nature of legitimate assumption. The fact of development itself, which is as certain as the theory of gravitation, does not appear, on the whole, to be directly attacked. (Mr. Charles E. Bell, in his excellent letter [1814], confirms my opinion as to the difficulty of making out "Commentator's" meaning.)

I. The real cause of any phenomenon is properly the *tout ensemble* of the conditions necessary to bring it about. But we seldom use the word "cause" in this sense; nor do we generally speak of the permanent essential properties of bodies as the cause of phenomena, although, in fact, they are necessary conditions; *e.g.*, we never say that it is the strength of the boiler-plates that drives the steam-engine. In speaking of cause we use the term mostly with reference to an antecedent, which, being introduced into a group of more or less permanent conditions, a certain consequent invariably follows it.

Further, there are proximate causes and ultimate causes; the ultimate or final cause of all, we can, of course, never understand.

"Commentator's" difficulties obviously originate in not discriminating the various kinds of causes. Natural selection is one of the proximate causes of evolution. The inherent potentialities of the organism, including "the million-times-proved-fact of variability," may be considered as a more or less permanent group of conditions, into which the antecedent, viz., natural selection being introduced, the consequent, viz., development results under certain circumstances. No doubt the organism has a power of adjusting itself to its environment, and by mutual interaction a modification of the organism takes place. Darwin probably did not give so much prominence to this fact as some of his followers, *e.g.*, Mr. S. Butler; but the fact, so far from being opposed to natural selection, is rather complementary to it; nature selects the fit—the fitness may have been acquired, so to say, accidentally or by adjustment—and kills off the unfit. But, indeed, adjustment is implied in the very conception of life. H. Spencer defines life as "the continuous adjustment of internal relations to external relations." It is, therefore, quite legitimate to say that natural selection is a cause of evolution.

"Commentator" appears in certain passages to insist on the inherent potentiality of the organism as the sole cause of development. It is certainly a condition of evolution, and is the unusual case in which the *tout ensemble* of the conditions is regarded as the cause; the inherent potentiality necessarily forms part of the cause. But what do we gain by talking in the vague language of which "Commentator" is so fond, about "predestined development," the "I am," &c., if we know nothing of the mode of operation of such forces? We have only, in another form, the celebrated explanation of opium causing sleep because it possesses soporific qualities. To say that organisms possess evolutionary energy, and, therefore, they develop, explains nothing. And "Commentator" himself is not quite satisfied with thus settling the matter, for he still calls out for "the cause, the cause," failing to distinguish causes that can be known from the final cause, which, as our knowledge is relative, must ever remain unknown to us. Darwin has shown us certain proximate causes of development, and others have further elucidated the subject. Why, then, should we despise causes that can be known, as "Commentator" would have us do, because we cannot reach the ultimate cause? It is as vain to cry after the final "cause, the cause, my soul," as for a baby to cry after the moon. We may well console ourselves when we compare the knowledge of the present day with that of former times.

"Es ist ein gross Ergötzen,
Sich in den Geist der Zeiten zu versetzen,
Zu schauen, wie vor uns ein weiser Mann gedacht,
Und wie wir's dann zuletzt so herrlich weit gebracht."

II. "Commentator" and "Gamma" [1766] appear to have but vague notions as to the nature of legitimate and illegitimate assumptions. J. S. Mill writes as follows with reference to hypothesis:—

"It appears, then, to be a condition of a genuinely scientific hypothesis that it be not destined always to remain as hypothesis, but be of such a nature as to be either proved or disproved by that comparison with observed facts which is termed verification. . . . I conceive it to be necessary, when the hypothesis relates to causation, that the supposed cause should not only be a real phenomenon, something actually existing in nature, but should be already known to exercise, or at least be capable of exercising, an influence of some sort over the effect."

Newton, however, among certain classes, is considered a higher authority than Mill. The following is the first of the celebrated "Regulæ Philosophandi":—"*Causas rerum materialium non plures admitti debere, quàm quæ et veræ sint, et earum phænomenis explecandis sufficiant.*"

According to these principles the assumption of natural selection as a cause of development is perfectly legitimate.

T. Common.

THE STILL SMALL VOICE FROM THE FOSSIL GREAT DEEP.

[1841]—Marvellous! this tiny "note of preparation"—as it were like the entrance of "the Son of God" into the world—the first appearance, amid all those unspeakable monster forms and giant-lives of the Triassic and Jurassic epochs, of mammalian life—the first relics of small marsupial animals, "allied to the Myrmecobius or Banded Ant-eater of New South Wales" (Geikie).

How did they come there?—"that is the question!"

Does not this confirm what was lately suggested:—"is it not monstrous to hypothesize? yon cat, *suckling* her kittens, was evolved out of yon pigeon in the chest beside her, *pumping* maize into *her* young!"

Horrific saurians, and bird-like reptiles (or reptilian birds) were the full-grown companions of these tiny marsupials. No wildest dogmatist of the Darwinian school would maintain that these charming creatures were lineally begotten of the Dinosaurs, Gnaliosaurs, Pterosaurs!—he must, therefore, *de novo*, fall back upon his ever-ready, all-too-convenient, Common Progenitor.

Now, I do submit, that the theory which maintains, the *Saurs* and these bijou marsupials were evolved from one and the same protoplasm demands rhadamanthine scrutiny, indeed; is bounden to furnish at least a scrap of *proof.*

With reference to Dr. Geikie's work, learned and laborious though it be, I cannot refrain from here entering a small protest. I never knew a book more greeted with flourish of trumpets, yet I find Hugh Miller—Scotia's happier Burns; with that heaven-born style, that aroma of fragrance lavishing (yet continently) more genius in one of his chapters than the Bigwigs in one of their books—Hugh Miller does not appear to be mentioned, *mirabile dictu!* in Dr. Geikie's chapter on the Old Red Sandstone; the Old Red! Hugh Miller's formation! he who *discovered* the Pterichthys, and whose honoured name Agassiz gave to that fossil (Pterichthys Milleri, "the Old Red Sandstone," p. 82—a prose poem if ever there was one); but Dr. Geikie does not give.*

The sketch too, of "Vesuvius from the sea" is so unlike that I did not recognise the mountain; though I have dwelt near it almost ten years.

Alexander Teetgen.

Ana Capri, Italy.

OCULAR SPECTRA.

[1842]—What on earth does Mr. Cave Thomas mean in letter 1815 when he writes: "The important fact that the *ocular spectra* have no external existence whatever does not as yet appear to be fully recognised?" Does he mean the *ocular spectra* are like Mahomet's coffin, suspended in mid space, acted on by neither the laws of gravity nor the rules of spiritland? Surely the fact is about as important as the fact that when I have a pain in my stomach I cannot show the doctor where it is, but when I cut my finger I can. Does Mr. Cave Thomas argue that because we see the sun above the horizon for a few minutes after it has set that what we see has no external existence or physical basis? Surely were our instruments sufficiently good should we not see actual molecular motion in the retina of the eye which sees the ocular spectra, and is not that motion the consequence of previous motion set up by the reflection of sunlight by the coloured figure?

Jos. W. Alexander.

THINGS IN GENERAL, AND A FEW OTHER SUBJECTS.

[1843]—Our Prince of Paradoxers, "Hallyards," reminds me irresistibly of Mr. Lewis Carroll's walrus:—

"The time has come," the walrus said,
"To speak of many things;
Of shoes, and ships, and sealing-wax,
And cabbages and kings,
And why the sea is boiling-hot,
And whether pigs have wings."

The walrus was versatile—so is "Hallyards." "Hallyards" has original opinions on scientific subjects—so had the walrus.

In Knowledge for July 3 Mr. Proctor somewhat earnestly disclaims some opinions, the honour and glory of which "H" had proposed to share with him. In Knowledge for July 17 "H" (in a postscript nearly a column long) appears to contend that Mr. Proctor must have held those opinions. One reason given is particularly rich:—"When a man writes a great deal, he cannot possibly remember all he writes." Then, if I cite "H." as an authority for the statement that "twice two are five," and if "H." repudiates it as something he could never have written, I have only to reply, triumphantly, "when a man writes a great deal" (which

[* The only mention of Hugh Miller's name that occurs in Dr. Geikie's book is on p. 277.—Ed.]

"H." certainly does), "he cannot possibly remember all he writes." There is no fallacy in this of course. Oh, dear, no!

In KNOWLEDGE for July 10, a very complete reply (letter 1804) is given to "H.'s" bit of metaphysical mystification about "infinite divisibility." In the letter immediately following, the walrus —no, I beg his pardon, "Hallyards" (but they are inextricably mixed in my mind)—demolishes the law of gravitation on the very sufficient ground that a gas acts like a gas, and not like a solid. In KNOWLEDGE for July 17, "H." returns to the charge on the subject of infinite divisibility, but he persistently ignores the distinction between space and matter which was pointed out to him. An atom is indivisible not because it is too small to be divided, but because we have no means of dividing it. To this may be added that if we had the means of dividing the atoms of substance, say, oxygen, we should get *something*, but that something would not be oxygen. Let "H." get a heap of shot and a paper knife. He may divide the heap until he comes to single shots. These are (with the means he has) indivisible. But does it follow that the space each shot occupies is indivisible? "H." might find means to divide the shots further, either by smashing them with a sledge-hammer, or by putting them in an acid. The result in either case would not be shots, but *something else*. Talking of shot, I cannot help thinking that "Hallyards senior" brought down that 40 ft. condor by a weapon well-known to great travellers, and used by several who have given their names to parts of the earth's surface —the *long-bow*.

Don't be alarmed, Mr. Editor, I have no intention of following "H." through his whole range of subjects, "the comity of nations," "printers' devilry," blunders about quotations, solar myths, garden slugs, the man in the moon, &c. I would not if I could, and I am not a walrus. I propose to construct an index of all the subjects on which "H." has treated, and I have a strong suspicion that if ever completed it will be an example of the "infinitely divisible." A great deal of it surely belongs only to the "Paradox Corner."

W.

LAMMAS.

[1844]—"Mr. G. L. Gomme is satisfied that in the customs of Lammastide (1st of August) 'we have the key to the whole system of ancient agriculture.' The one great custom, he remarks, that links it with a very remote past, is the removal of fences from lands that were held in common by the village community, but which had to some extent been inclosed for individual proprietorship since the preceding Lammastide—a custom that prevailed with much curious variation on the South Downs in Sussex, besides other places, till within the last 50 years, even if it be *not* [?] yet extinct. His paper must be read as a whole in order to understand the force of his argument; the custom at any rate seems to have but weak connection with the reputed meaning of the word, which, like the other great mass days, involves a church offering, whether of a lamb, as sometimes explained, or of a loaf (*hlaf*)."—*Saturday Review* on "The Antiquary," vols. vi., vii. Oct. 27th, 1883.

Differing from the Reviewer above, I would suggest that the Lammas custom has the closest connection with the real—though not, indeed, with the reputed meaning of the word. Lammas in French is "St. Pierre-ès-liens." This word *lien* in English has come to have only a moral meaning, and to be pronounced (I think) like "lean." But when French was current in England, it was no doubt pronounced "*lyēan*," and used of material bonds. The mass would naturally be called "Lienmas"—or perhaps "Léanmas"—for *liane* in French means a *withe*—and then you have the word at once, without going to purely gratuitous hypotheses about lambs and loaves. The probability of this derivation would be greatly increased if it is the case that the feast was not known in England before the Norman Conquest; and this does seem probable. It is said in the lessons for the day in the Roman breviary that Eudacia, wife of Theodosius the younger, was presented at Jerusalem with the chain (*i.e.*, *one* of the chains) wherewith Herod bound St. Peter; which she sent to her daughter Eudoxia at Rome, who brought it to the Pope, and he then shewed her the chain wherewith St. Peter was bound by Nero; that the two joined themselves together so as to seem the work of one artificer; that thence a church was dedicated on the Exquilæ under the name of St. Peter in Chains, and a feast assigned on the 1st August, till then occupied with surviving idolatrous festivities: the chains working miracles—*among which* in 969 a certain Count, a friend of the Emperor Otho, was delivered from a devil by contact with the chains: "*ac dienceps* in urbe sanctorum vinculorum religio propagata est." From which last concluding sentence I feel inclined to infer that the feast really dates from the end of the tenth century. It may not have been introduced into England till much later; Trinity Sunday was introduced only by St. Thomas Becket in memory of his own consecration on that day. If this be so, the feast would not be known to the pre-Norman English; and this would account for its not being called Bondmas, or any like name. The removal of the hurdles is, of course, a very graphic way of commemorating the falling of the chains from St. Peter's hands.

HALLYARDS.

MICHAELMAS.

[1845]—"Mr. Edward Peacock has a congenial subject in Michaelmas." [Does this mean that the great goose-feast must be interesting to all peacocks?] "Multitudes of angels, according to Jewish tradition, are created daily, but no archangels. These are limited to the original four who first spread their mighty wings at the birth of all things. The respect in which St. Michael is held, beginning with Satan himself, extending to Mahommed, coming down to John Bunyan, and continuing to now, is owing to his character as protector of the people of God. The Devil could not bring against him a railing accusation when the two disputed for the body of Moses." [This must allude to some little-known tradition; for St. Jude says, quite contrariwise, that *the Archangel did not dare* to bring, &c.] "The enemy of Michael is the enemy of God, according to the Prophet of Islam; and it is curious that so unsparing a bruiser of saint-worship and Popery as the man of Elstow should make his hero in his terrible fight with Apollyon call upon the prince of the archangels for aid; at least the winner in the conflict confesses to have done so with success in his after-pæan:—

> But blessed Michael helped me, and I
> By dint of sword did quickly make him fly—

that is, Apollyon."—*Saturday Review* on "The Antiquary," vols. vi., vii., Oct. 27, 1883.

The aid of St. Michael in Christian's conflict with Apollyon is just one of those anomalies which favour the theory that the earlier part of the P.P. was pirated by Bunyan, and is of pre-Reformation date. The Reviewer by the way errs in saying that Xn. either invoked St. M. or says he did so. He merely says that St. M. helped him. Any Protestant could say this: but the curious thing is that in the account of the conflict there is no mention of St. M.; and that in the last lines of the little hymn Xn. thanks "him"—"his holy name"—(*sic* in 1st Edn.)—there having been *no mention* of God whatever. Later editions have capital H's; exactly as in Exodus, where it is said "he" (Moses) wrote on the tables—which in our bibles is printed "He" to make it agree with the other account in Deuteronomy. If Bunyan had *meant* God, what reason can be assigned for his not having written it? HALLYARDS.

THOUGHT-READING.

[1846]—Since writing the letter, 1769, in which I alluded to the theory that possibly a rudimentary sense or organ in some minds or brains might account for the phenomena of thought-reading and mesmerism, I have carefully applied the theory to each case of thought-reading recorded in KNOWLEDGE, Vol. VI. pp. 364, *et seq.*, with this result.

The first set of experiments refers to the guessing of the names of persons and things, and there appears no difficulty until we get to *cork*, which is guessed as *fork*. The only explanation I can see is that the questioner instead of having the idea fork in his mind had that of the word "fork" written or printed, or of the sound of the letters f, o, r, k; but then the experiment *tongs*, guessed as *fire-irons*, *poker*, wants exactly an opposite explanation. I will now refer to the experiments carried on at Liverpool by Messrs. Guthrie & Birchall. A gold cross is guessed first as something yellow, then as a cross. In this case one would like to know whether the questioner arrived at the idea by this process of reasoning, or whether he was looking at a gold cross. The next answer is remarkable—"Looks like an egg." It seems, therefore, that the thought-reader sees the things he is thinking of; for, again, in the next experiment, "a penholder with a thimble inserted on the end of it" is guessed as "a column with something bell-shaped turned down on it." It seems to me that much depends on the idea as conceived by the questioner. Supposing the questioner to be looking at a golden cross, one can imagine the image of a yellow cross appearing in the thought-reader's brain; but it seems to me that, if the questioner were merely thinking of a golden cross, the idea of gold *et hoc genus omne* rather than yellow would be produced in the thought-reader's brain. In a former letter I stated that whether we see a cannon fired, hear the report, or smell the powder, the same idea may be produced in our brains, namely, a cannon has been fired; but, as I am personally constituted, the idea "a cannon has been fired" neither pictures to my brain the smoke coming out of the muzzle, nor produces in my ears the sound of artillery, or in my nose the smell of sulphuretted

hydrogen, but rather makes me conscious of the idea in the abstract It may be said that there is no such thing as an abstract idea, and that we cannot think of virtue, but must conceive some particular act of virtue. Even if this be the case, we do not, I think, picture that particular act being performed by a particular person; nevertheless, in every case of thought-reading recorded, the thought reader apparently pictures to himself something. He seems to be seeing something. He says: "A little tiny thing with a ring at one end and a little flag at the other, like a toy flag. It is very like a key." All the experiments recorded in the article seem to show that this, at any rate, was the idea of the writer, and that the experiments were selected accordingly. One would like to know what the experiments were which were considered unworthy of record.* It would be most unscientific to suppose that, if this rudimentary sense exists, only a very few possess it. If it exists in a few to such a marked degree as thought-reading experiments appear to prove, ordinary individuals must possess it in a less marked degree. Any one who has played the old game of "letters"—I mean the game in which one person forms a word, shuffles up the letters and gives them to another person to guess, knows how difficult it is to find out a word unless he sees it at once. In fact, my personal experience is, that I can guess the word before I have properly seen all the letters, or I must find it out mechanically by arranging the letters according to their most probable combinations. I used to think that I saw the letters *en masse* before I had time to notice any particular arrangement, and that they arranged themselves unconsciously into the word, but that when I noticed a particular arrangement of some of the letters as they lay, it suggested a particular word containing that arrangement. Still the arranging themselves unconsciously in my brain was still unexplained. But supposing the person giving the word was thinking of it at the moment it was given, and thought-transference possible, what otherwise is inexplicable is explained. Nevertheless, I am willing to admit that the arrangement and re-arrangement of letters does go on in my brain unconsciously. For instance, frequently when asked a person's name, all I can remember is the first letter, the number of syllables, and some, if not all, of the letters, but wrongly arranged. Curiously, in some of the answers given by the thought-readers, some such confusion is produced. For example, the questioner thinks of the name "Albert Snelgrove," but the answers given are "Albert Singrove" and "Albert Grover." Here the cause must be different, for in my case I am trying to recall something I have forgotten, but the thought-reader is trying to find something out. It seems to me clear that no progress can be made in the elucidation of thought-reading phenomena until it is clearly understood how ideas arise in the ordinary brain. In my own case, if I wish to fix an idea instead of picturing the thought, I seem to inaudibly repeat words which convey the idea, but this is not until after I have got the idea. So I suspect the thought-reader in many cases does the picturing after having taken in the idea, and works out the picture from the idea and not the idea from the picture. I cannot myself help thinking that when a compound idea becomes a conscious thought immediately on conception, that the action is direct, and not preceded either consciously or unconsciously, by a series of simple ideas leading up to the compound idea. What I mean is this, I see 23, as written, and the idea *twenty-three* is immediately conceived in my mind. Possibly there was a time when I should have had to have thought it out in this manner, the 3 is in the units' place and the 2 is in the tens', therefore it is twenty-three. But another time I see 2,000,003. Before I can pronounce it two millions and three, I must count the number of figures. It is not that the eye cannot take in so much at once, for three cows are as easy to count without counting as the angles of a triangle, and ten cows no more difficult than those of an irregular decagon. (Of course, the case of the Irishman's spotted-pig, which would run about and would not be counted, is an exceptional one.) Now, this forming a complex idea at once must have a most important bearing on the subject of thought-reading. It is evident the thought-reader and *thought-readee* must both be of the same mental calibre to obtain accurate reciprocity of thought. For instance, a capital C would probably suggest cat to my little boy, but to me it might suggest 100. It seems to me, therefore, for the theory of brain communication to be possible that it is almost necessary that an idea which is communicated should be a simple one. The theory apparently is that a certain particle, A, in a certain brain, B, has a certain motion, which produces a certain idea, C; that this motion produces an ether wave which sets in motion a particle, A′, in a brain, B′, which causes an idea, C′, similar to idea, C; that A B and C stand in the same relation to one another as A′ B′ and C′. The main difficulty seems to be this, supposing two or three persons present during an experiment, the brain of each must be sending off ether waves at the same time, and how does the thought-reader select the right one? Yet possibly this is the explanation of thought-reading. Thought-reading is not a particular or peculiar power of reading thought, but the power of concentrating the attention on one particular brain. Just as some persons can concentrate their attention on one person and listen to him in a crowd of talkers, when others only hear a buzz and cannot follow a single conversation. Another difficulty is the improbability of two brains being so similarly constituted that molecular motion in one should produce similar molecular motion in another. I see colours different shades with my right eye to what I do with my left. Mr. Proctor somewhere states that one of his eyes is short-sighted and the other long-sighted. In these cases the same exciting cause produces different ideas in the same person. Nevertheless, an inarticulate cry for help will set twenty persons running to the same spot, each having a very similar idea to his neighbour, or, at any rate, an idea quite as similar as the theory of direct brain communication seems to require. Whether physiologically the fact of a certain molecular motion producing a certain idea will ever be demonstrated or not, it is pretty certain that for every thought there is a corresponding molecular motion in the brain.

How calculating boys work out sums unconsciously, which mathematicians require pencil and paper for, seems more easily explained by a theory of thought-reading than in any other way, as the gift is lost as the intellect grows.* How we are able to follow the argument of a lecturer on a difficult subject by means of our ears alone (in some of us very imperfect organs) I do not know, unless our brains get into accord in some way; for frequently I have known the meaning of what a lecturer has said, and yet when I have tried to catch his exact words have found I could not distinguish them. On the other hand, I have frequently read a sentence over and over again without getting any meaning out of it.

Any one playing with young chess-players must have noticed how often, after waiting ten minutes or so for his adversary's move, which eventually is the wrong one (say leaving a piece *en prise*), that the young player, just as the hand is stretched out to take the piece without ever having touched the men, shouts out, "Wait a minute, please, I see a better move," and immediately puts the piece out of danger. Of course, some one may say it is no more wonderful than seeing a revoke the moment you have exposed the card—a most unfortunate trick of young whist-players—but here again, I say, it is some one else sees the revoke first. I really believe, if thought-transference is admitted, it will explain many circumstances which are now either called coincidences, or explained by a sharpness of sight and acuteness of hearing combined with a quickness of intellect and sensitiveness of touch more wonderful even than the disintegration theory of Madame Blavatsky and the Cashmere pundits. JOS. W. ALEXANDER.

[* I am entirely in accord with Mr. Alexander here. The aphorism of Lord Bacon, that men are more apt to mark when they hit than when they miss, is singularly pertinent to such investigations as those on which our correspondent is commenting.—ED.]

[* I think it was De Morgan who suggested that this occult power of calculation rather pointed to some hitherto undiscovered property of numbers; perhaps akin to logarithms.—ED.]

LETTERS RECEIVED AND SHORT ANSWERS.

H. D.—I should have fancied myself that the force with which any fluid, such as air, acted perpendicularly upon a plane obliquely opposed to it, varied as $\sin^2$ of the inclination of the plane to the direction of the current. Try this formula. I cannot at this moment refer you to any book in which the matter you are interested in is specially treated of. Moreover, I know of no work following on the lines of Barlow's "Mathematical Dictionary" which has since been published. No recent edition of it exists. —MASON. The Pyramids are chiefly built of the natural nummulitic limestone obtained either from the mountains near Cairo, or from quarries on the west side of the Nile; but also of granite, &c. The stones employed in its construction are of all sizes, some of the granite slabs being 17 ft. long by 3 ft. 9½ in. wide. As the Pyramids are built in a series of gradually diminishing platforms, it is probable that the stones were raised by a system of levers. Moreover, Herodotus tells us that the Great Pyramid occupied twenty years in erection, and that 100,000 men were employed in its construction. Human life was, of course, as cheap as dirt, and a Pharaoh would think as little of killing fifty men in raising a huge mass of stone by manual labour as he would of destroying the same number of flies.—LEONARD MORGAN BROWN.

Your letter is obviously intended for the Conductor of KNOWLEDGE, who is at present absent from England; whither, however, he will return in the course of a fortnight or so. I greatly fear that it will be as much out of his power to grant you a private interview as it is out of mine. The time of an editor is occupied in a fashion of which the outside world has not the most distant idea. Those who picture him as sitting in an easy chair with an old Cabaña in his mouth, only waiting for the pleasure of half-an-hour's chat with a visitor or correspondent, indulge in a veritable Alnaschar's dream.—HUNDREDWEIGHT. The change of declination in the sun in January is not particularly rapid, notably at the beginning of the month. Still this *may* have produced a portion of the discrepancy. See Chauvenet's "Spherical and Practical Astronomy," Vol. I., p. 244. I should, though, myself be disposed to attribute the major part of it to irradiation, incident on the small power of the telescope and the eye-shade not being dark enough. Many of the shades furnished with sextants are far too light-coloured.—JAMES U. ROBERTSON. Do you seriously suppose that under the scarcely veiled pretext of describing a manufacturing process I am going gratuitously to advertise that you have shares of a company for sale? —H. F. YOUNG. If you wish to form a correspondence class, you must advertise in Mr. L.'s form. It is absolutely out of the question that such a class should be formed in connection with KNOWLEDGE itself. You might just as well ask me to lay in a stock of the various articles advertised in these columns, for retailing among its subscribers.—G. DUNCAN. Kindly read the paragragh in capital letters, which concludes those heading the correspondence columns. The conductor has nothing to add to his printed testimonial, which you must consult and draw your own inference from.—DR. LEWINS desires to put on record (for the *n*th time) that "all Hylo-Idealism requires is the categoric belief that the body is the real man—that this body is part of, not apart from, the circumambient universe, known to us only by sensation and thought, which are not external entities, but strictly functions, *i.e.*, creations of the same organism itself." He further wishes to direct the attention of readers to the article "Animism" in the 9th edition of the "Encyclopædia Britannica," to the volume on "Cause and Effect" by Dr. Thomas Brown, and to Mr. Fraser's article "On Ghosts" in the *Contemporary* for July.—HON. EXAM. '85. I have stated over and over again here, that I am not a crammer or coach, and that I must absolutely decline to do sums or solve equations or problems set in any examination whatever.—ALFRED GORSTON. It could only be accepted as a voluntary contribution.—CAPT. F. DE RICHELIEU. Much too long, and not of sufficient popular interest for insertion.—E. W. J. The papers on the "Morality of Happiness" have not as yet been reprinted. Whether they will form part of a future volume of the "Knowledge Library Series" has yet to be discussed and decided on.—T. H. GARFIT. Thanks, no. The subject is outside of those to which this journal is devoted. Undoubtedly, a Platyscopic lens is much more useful as a *microscope* than a common shilling hand lens.—THE GHOST OF JOSHUA. Any man who says that the sun at the North Cape at this (or any other) season remains virtually over the same point of the horizon for twenty-four hours, merely altering its altitude above it, lies—under some astonishing mistake.—A. BROTHERS. Conductor still in America. When your spectral image is projected on a distant background of course it looks monstrously bigger, as its angular dimensions remain invariable. If you could remove a little bush on to the horizon, preserving its angular subtense at the eye, it would look like a huge forest. *Vice-versâ*, any object brought from a distance, if it were possible, without the enlargement of the angle under which it is viewed would appear less.—ECLIPSED. The origin of the symbols of the zodiacal signs —as also in fact that of the signs themselves—is obscure. Some of them are tolerably apparent, *e.g.*, ♈ the ram's horns; ♉ the bull's head, and so on. The ♍ concerning which you are exercised, stands for Maria Virgo—the Virgin Mary. ♑ is formed by joining the two letters τρ; the beginning of the Greek word τράγος, a goat. ☿ is the caduceus of Mercury, ♀ the looking-glass of Venus, ♂ the shield and spear of Mars, ♃ the arm of Jove holding the thunderbolt, ♄ the scythe of Chronos or Saturn, &c.—JOSEPH KIRK. However much the ingenuity of your argument would entitle it to admission, it is perforce excluded by its essentially theological character. Of course you turn professedly literal history into pure allegory—but that is a detail.—R, A, H. I expect that the Conductor will be in England on or about the 8th prox., when your proposal shall be submitted to him.—A. KOROBOFF. The Roman Catholic sect and that of the Greek Church may be all that you aver; but it is utterly out of the question that I should reproduce your appeal to M. Jules Ferry here, or afford space for your claim to be the regenerator of the world.—S. FLOOD PAGE. The Directors' Reports of Commercial Companies can find no place in these columns.—WM. MCKENZIE. Needlessly detained through being addressed to the *Editor* instead of the publishers.

Our Inventors' Column.

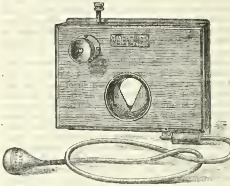
PHOTOGRAPHIC SHUTTER.

[Patent No. 7,792. 1884.]—In exposing sensitive plates for instantaneous photographs it has always been a desideratum to obtain a comparatively longer exposure for the foreground than for the distance.

This result is obtainable by use of this shutter, patented by Mr. Heath and manufactured by Messrs. Marion & Co., in the following manner:—Two plates are cut obliquely and made to pass over one another, in opposite directions, by a parallel motion, the result being that in their transit the bases of the apertures exposing the lower portion of the lens are the first to be uncovered and the last to be closed, thus very greatly increasing the proportionate exposure of that portion of it.

The movement is communicated to the plates from a coiled steel spring, by means of arms with slots, traversing and driving pins in the same.

A break is attached by which speed can be reduced from an instantaneous exposure to one of two or three seconds. The spring working the plates is released by the depression of a small stud shown on the bottom of the frame. This is accomplished by urging forward a small piston in the cylinder adjacent to the stud. The pneumatic device patented by Cadet is employed for this purpose.



Photographic Shutter.

Rick-cover Fastener

FASTENING RICK-COVERS.

[Patent No. 9,040. 1884.]—H. G. Norrington, of Benhay-road, Exeter, has patented a simple but effective fastener for fixing galvanised corrugated iron sheets, now generally coming into use, to both hay- and corn-ricks. It is applied by punching a hole on the top of a corrugation in the sheet, inserting the end of the fastener, and screwing it in, when it draws itself into the rick, until the grooved washer firmly fixes down the sheet, the groove at the same time fitting the corrugation so as to prevent any rain entering the hole made. There are many advantages apparent to agriculturists in being able at any time to permanently cover their ricks without having to wait for a thatcher. Curved sheets can be used for the ridges, and ventilation, if necessary, can be secured by leaving the space between the hay and the ridge.

SLIDING-SEAT FOR RACING BOATS.

[Patent No. 11,829. 1884.]—This invention, by Mr. J. C. Green, of 21, Great Southsea-street, Portsmouth, is fitted with rollers, the application of which causes the seat to work with less friction than exists in the ordinary sliding-seat. The rollers are placed so that the seat runs true, and they are so fitted that if the boat happens to be off her level keel, the working of the seat is not affected. The difference claimed, therefore, in the working of the ordinary sliding-seat and the "Improved Sliding-Seat" is:—That the amount of force, which is required to overcome friction in the former, is with the improved seat made available for materially increasing the speed of the boat. With this invention, therefore, a speed can be attained which it is impossible to produce by the use of the ordinary sliding-seat. The latter bears directly upon the slide-rods without any medium, whilst the "Improved" seat has rollers fitted between the wooden seat and slide-rods, which cause the seat to run easier than the ordinary sliding-seat.

Our Whist Column.

By "Five of Clubs."

WHEN *NOT* TO LEAD ACE.

I HAVE shown why the accepted leads of the Ace from length are sound. These leads are two only, viz., from Ace four others, not including the King; and from Ace, Queen, Knave, with or without others. (But Continental players usually lead Ace from Ace three others, and among Americans especially in the West one too often notices the unsound lead of Ace from Ace, King, and others,—though, I need scarcely say, one does not observe this among American players of the game of Whist, properly so-called. (Unfortunately players of this class are few, in America.)

With regard to the lead of Ace from Ace three others, we may admit that it is sound enough in itself. I prefer the lead of lowest from such a suit even on general principles, but I cannot deny that there is much to be said in favour of the Ace lead. It is usually a safe lead, like the French opening at Chess. The Ace is almost certain to be made; and by leading out another round immediately, the suit is generally too well cleared for the weakness of the leader to cause serious mischief. It may happen, of course, that one of the enemy have length in the suit, and that giving up the command means throwing several tricks into the opponents' hands. But usually the lead of the Ace from Ace three others turns out well enough. Still, the chance of making the Ace second round is so good, and the result to the hand so much better if Ace is thus made than if it is made first round, that for my own part, unless where the game is in a critical state, so that no certain trick must be risked, I consider the small card the best to be played on general principles.

What, however, would turn the scales if they were more nicely balanced than they are, is the circumstance that by rejecting the lead of Ace from Ace to four, we keep the meaning of the Ace lead plainer. It is limited to two cases, instead of three, and the language of the game is made so much the clearer. This would be an insufficient reason if the lead of a small card from Ace to four were bad in itself. For the object of play is to make tricks, not to talk to one's partner through the cards. But as the lead of the small card is at least as good as the lead of the Ace for trick-making purposes, the circumstance that the lead also helps to make Whist conversation clearer, constitutes an important advantage. Mr. F. H. Lewis's remarks on this point are excellent (they are quoted at p. 159 of my little work "How to Play Whist"):—"I am in favour," he says, "of leading a small card from Ace to four originally, and also in the course of the hand, unless in the latter case, the play of the previous suits has shown an irregular division of the cards, in which event the Ace might be in danger: I am in favour of thus leading a small card, because I am in favour of uniformity at Whist: I lay no stress whatever upon the argument that uniformity gives information to the adversaries as well as to partner."

About the other case in which Ace is led wrongly, there can be no question. There is no division on this point between the players in England, those on the Continent, and those in America; yet there is no error about which bad players are so positive and persistent, as about this lead,—viz. of Ace, from Ace, King, and others. Of course every Whist player leads the King in such cases; and from Hoyle's time to the present there has never been any division of opinion. Yet, those who lead the Ace are full of arguments (or what they regard as such) in favour of their way of leading.

The learner's chief difficulty on this point is to know how it can matter whether the Ace or King is led: to which, when they are a little more advanced, they add that as the highest of a head sequence is usually led, the lead of King seems an unnecessary exception. To these negative objections it is a sufficient answer to say that there are already two accepted leads of Ace, and there is but one other case (besides Ace, King, and others) from which King can *possibly* be an original lead,—viz. from King, Queen, and others; so that if it is a matter of indifference whether Ace or King is led, so far as trick-making is concerned, it is obviously best to lead the King so as to distinguish this lead from the two cases in which Ace is led originally. As against this advantage, the exceptional nature of the lead of the lower card of a head sequence is as nothing,—rather it serves to emphasize the significance of the King lead.

But positive objections are urged by those who are not students of Whist, indeed regard themselves as better able to teach than to learn, against the lead of the King. For say they, the King may be trumped by your partner, unaware that you hold the Ace also; whereas if you lead the Ace, of course he passes the trick. This particular objection, which I have heard now about a hundred times, affords a good measure of the quality of bumble-puppy players. It assumes, practically, that either you would lead a singleton King, or that having King and others (not including Queen) you would lead the King for the sake of giving your partner a ruff,—this, too, as an original lead. One lead or the other it must be to justify their reasoning; for the lead of King from King Queen which has been uniform with Whist players since Hoyle's time, these folks utterly reject. Now if I had a partner whom I knew to be so bad a player that he would lead King single, or King from King and others not in sequence with it, for the sake of getting or giving a ruff (except where a single trick would save or win the game), I might ruff his King without remorse, knowing that nothing could spoil *his* play, and that that *might* be what he wanted. But to ruff a King led by partner (unless in a case presently to be considered) would be such atrociously bad play, that no one but a bummble-puppist could imagine so gross an offence against Whist principles. If I *knew* fourth player held the Ace (say through his having exposed the card early in the game) I should play atrociously were I to ruff my partner's King,—seeing that his only conceivable object in leading it under ordinary conditions would be that he might draw the Ace and obtain command of his suit.

This particular objection only avails then to show how little the bumble-puppist appreciates the principles of the game. He has no idea of the importance of obtaining or retaining the command of suits, whether as a measure of offence or of defence. His only idea is to capture a trick when he sees the chance, even though he may ruin his partner's strategy and lose three or four tricks by so doing.

The chief direct advantage of the King lead, from Ace, King, and others, is that should you see fit from the fall of the cards to discontinue the suit, your partner knows almost certainly that you have the Ace left, whereas if you lead the Ace and then stop he would not know that you have the King.

In one case only should you lead Ace from Ace, King, and others:—If you have trumped one suit, and led King, your partner might think you saw an opportunity of establishing a cross ruff or of at least getting another ruff in the suit you had trumped, and therefore would be apt to trump your King, if he had none of the suit. To avoid this, it is best in such a case to lead Ace first and then King.

Since 1810 the Municipality of Aberdeen has spent £1,033,000 on harbour works. In 1811 the revenue amounted to £1,214; in 1835, it was £13,635; in 1860 it had risen to £27,443; and in 1884 it reached £58,293.

A temperature of 570° will produce a dark blue colour on polished steel, and 590° a pale blue. Oil or grease of any kind will answer for drawing the temper of cutlery. The temper for lancets is obtained at 430° Fahr., axes at 500°, swords and watch-springs at 530°, small saws at 570°, and large saws at 590°.

Specific Gravity of American Woods.—Of the four hundred and thirteen species of trees found in the United States, there are sixteen species whose perfectly dry wood will sink in water. The heaviest of these is the black ironwood (*Condalia ferrea*) of Southern Florida, which is more than thirty per cent. heavier than water. Of the others, the best known are the lignum-vitæ (*Guaiacum sanctum*) and mangrove (*Rhiziphora mangle*). Another is a small oak (*Quercus grisea*), found in the mountains of Western Texas, Southern New Mexico, and Arizona, and westward to the Colorado desert, at an elevation of five thousand to ten thousand feet. All the species in which the wood is heavier than water belong to semi-tropical Florida or the arid interior Pacific region.

New Gutta-Percha Tree.—Instigated by the threatened dearth of the gutta-percha tree (*Isonandra Gutta*), M. Heckel has sought a substitute, and claims to have found it in the *Birtyrospermum Parkii* (Kotschy) of equatorial Africa, and abundant in latitudes between Upper Senegal and the Nile, especially in the forests of the Niger and Nile regions. It affects the argillaceous and ferruginous soils of Bambarras Boure and Fonta-Djalon, where the Africans gather its fruit, which yields a grease called *karite*. The juice or milk is obtained by incision from the bark, and on evaporation resembles gutta-percha. M. Heckel states that he has sent seeds to various French colonies, and also to England, in the hope that the latter country will try the experiment of introducing the tree into her vast tropical possessions. M. Heckel also calls the attention of English botanists and chemists to the divers Indian *Bassias*, as he is led by analogy to infer that they might furnish milky products similar to the Bassia Parkii.

Our Chess Column.

By MEPHISTO.

INTERNATIONAL CHESS TOURNAMENT OF THE GERMAN CHESS ASSOCIATION.

Hamburg, July 25.

THIS tournament, which was played at Hamburg, attracted most of the best players of England and the Continent, as well as Captain Mackenzie from New York. The playing strength in this tournament, as may be seen from the list published below, was very considerable, and the number of competitors, eighteen, made the test severe. In addition to the well-known names of the English and Continental Chess celebrities, there appeared several German players, hitherto unknown to fame. Nonetheless, some of these players showed real first-rate capacity. One of them, Dr. Tarrasch, of Halle, quite a young man, at one time even looked like as if he would easily carry off the first prize, he having defeated Mason, who for the greater part of the tournament played exceedingly well, and was considered first favourite. The contest proved a very close affair indeed, so much so that on the very last day no less than five players had chances for the first prize, viz., Gunsberg, 11; Weiss, 11; Englisch, 11; Mason, 9½ (with two adjourned games); nd Dr. Tarrasch, 11½. It was an exciting finish. Blackburne, by defeating Dr. Tarrasch disposed of his chance for first prize. Englisch could do no more than draw with Berger, and Weiss likewise scored only a half against Mason. Gunsberg was the only one of the ve who vanquished his opponent Gottschall, his score being raised hereby to 12 against 11½ of Blackburne, Tarrasch, Weiss, and Englisch. Even then Mason, with 10, could have tied with him. The adjourned game, Mason v. Minkwitz, therefore attracted great attention. With great coolness, Mason played what seemed to be a hopeless ending in masterly manner. At one moment even it seemed as if his efforts would be crowned with success. Minkwitz, however, effected a draw. This left Gunsberg first prize-winner, with 12, against five such formidable and closely-pressing rivals as Blackburne, Mason, Englisch, Tarrasch, and Weiss, who each scored 11½, and divided from second to sixth prize. Next came Mackenzie, seventh with 10, and Riemann and Schallopp, both good players, with 9½. Gunsberg, in the first half of the tournament, scored 5 out of 9, and was little thought of as first prize-winner. Of the remaining 8 games, however, he won no less than 7, defeating amongst others Blackburne, Mackenzie, and Bird, thereby attaining his unexpected success. Below we give a game played by the first prize-winner.

Complete score list of the Tournament:—

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Score.
Berger (A)	—	½	½	½	½	½	1	½	½	½	½	½	½	0	½	½	0	½	8
Bier (B)	½	—	0	1	0	0	0	0	0	0	1	½	0	0	½	0	0	0	3½
Bird (C)	½	1	—	[illegible]	0	0	0	0	0	1	1	1	1	½	1	0	1	0	8
Blackburne (D)	½	0	1	—	1	1	0	1	0	1	1	½	1	0	1	1	1	½	11½
Englisch (E)	½	1	1	0	—	1	½	0	½	1	1	1	0	0	1	1	1	1	11½
v. Gottschall (F)	0	1	1	0	0	—	0	½	0	0	1	0	0	1	1	0	0	½	6½
Gunsberg (G)	½	1	1	1	½	1	—	1	0	1	0	1	0	1	1	1	1	½	12
Mackenzie (H)	½	1	1	0	1	½	0	—	0	1	1	½	½	1	½	1	½	0	10
Mason (I)	½	1	1	1	½	1	1	1	—	½	½	1	0	0	1	0	1	½	11½
Minckwitz (J)	½	1	0	0	0	1	0	0	½	—	1	½	1	1	½	1	1	0	9
Dr. Noa (K)	½	0	0	0	0	0	1	0	½	0	—	1	1	0	1	0	0	0	5
W. Baulsen (L)	½	½	0	½	0	1	0	½	0	½	0	—	0	0	½	0	0	0	4
Riemann (M)	½	1	0	0	1	1	1	½	1	0	0	1	—	1	½	0	½	½	9½
Schallopp (N)	1	1	½	1	1	0	0	0	1	0	1	1	0	—	1	0	1	0	9½
Schottlander (O)	½	½	0	0	0	0	0	½	0	½	0	½	½	0	—	0	½	½	4
Dr. Tarrasch (P)	½	1	1	0	0	1	0	0	1	0	1	1	1	1	1	—	1	1	11½
Taubenhaus (Q)	1	1	0	0	0	1	0	½	0	0	1	1	½	0	½	0	—	0	6½
Weiss (R)	½	1	1	½	0	½	½	1	½	1	1	1	½	1	½	0	1	—	11½

GAME PLAYED IN THE FIFTH ROUND ON JULY 15.

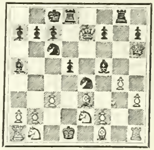
SCOTCH GAMBIT.

White. Schallopp.	Black. Gunsberg.	White. Schallopp.	Black. Gunsberg.
1. P to K4	P to K4	11. P × P	Kt × P
2. Kt to KB3	Kt to QB3	12. B to Q3	Q to R4
3. P to Q4	P × P	13. P to KKt4 (?)	Q to R6
4. Kt to P	B to B4	14. B to K4	Kt × B
5. B to K3	Q to B3	15. Q × Kt	B × P
6. P to QB3	Kt to K2	16. Q to Kt5	Kt × Kt
7. Q to Q2	Castles	17. P × Kt	B × P
8. B to Kt5 (?)	B to Kt3	18. R to KKt sq.	B × QP
9. Kt to R3	Q to Kt3	19. B to B5	Q × P
10. P to B3	P to Q4	Resigns	

Following, are two of the many pretty endings played in this Tournament:—

Position after White's 14th move in the game between Paulsen and Schallopp:—

SCHALLOPP.
BLACK.

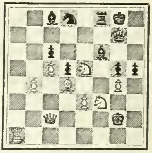


WHITE.
PAULSEN.

14.	P to Q5
15. P × P	Q to Kt5
16. P × B	Q to K8 (ch)
17. K to B2	Kt to Kt5 (ch)
18. K to Kt3	Q to Q sq. (ch)
19. K to R3	P to Kt4
20. P to Kt3	R to Kt3 !
21. P × R	Kt to Q6
22. B to Q2	Q × B !
23. Q × Q	Kt × Q
Resigns	

Position after Black's 34th move in the game between Mac- Tarrasch:—

TARRASCH.
BLACK.



WHITE.
MACKENZIE.

35. Kt to Kt6	P × P
36. Kt (B3) to K5	B × Kt
37. B × B	Q to KB2
38. Kt to K7 (ch) !	Resigns

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PLAINLY WORDED—EXACTLY DESCRIBED

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THE GREAT RED SPOT ON JUPITER.

By Richard A. Proctor.

PROFESSOR YOUNG in his farewell address to the Philadelphia meeting of the American Association for the Advancement of Science, spoke of the great red spot which has for many years been the most remarkable feature of the planet Jupiter as a mystery "probably hiding within itself the master-key to the constitution of the great orb of whose inmost nature it was an outward and most characteristic expression." Without altogether accepting the view of the red spot thus metaphorically presented, I must most thoroughly express my agreement with the opinion underlying Professor Young's rhetoric. The great red spot on Jupiter is undoubtedly the most mysterious of all the phenomena which even the Prince of Planets has presented to the student of astronomy. A vast opening, about 150 millions of square miles in extent, lasting many years, undergoing changes of shape and of position most remarkable in character, this great red spot undoubtedly contradicts emphatically all the old-fashioned ideas respecting Jupiter: and it as certainly presents many perplexing questions for those to answer who have adopted the more modern ideas.

Yet it has always seemed to me that the more remarkable a phenomenon is the better is it worth studying, and the more likely is it to reward careful study by truthful information. A perplexing problem of this kind may be compared to a complicated lock, which will not open to any ordinary key; but when a key which will open it has been found then may we feel well assured that that key is the right one; whereas when a commonplace phenomenon has been accounted for, we can have no more certainty that our solution is right than we can feel respecting a key (one perhaps among a dozen) which will open a lock of commonplace construction. Without claiming that as yet the correct solution of the problem of the great red spot has been found, or even that it can be, let us proceed to examine the problem with a view to the determination of at least some of the points which the true solution must interpret.

It was in the year 1876 that the great red spot was first observed—by Professor Pritchett of Glasgow, Missouri. But I have before me a picture drawn by Professor Mayer, of the Stevens Institute, Hoboken, in 1871, wherein the place afterwards occupied by the spot is marked by an oval ring of about the same size and shape. Whether this was actually the first beginning of the disturbance, or merely a coincidence, cannot now be very readily determined: but it is at least worth noting, even though it should be no more than a coincidence.

When first observed the great spot was symmetrical and well defined in shape, and of a somewhat strong ruddy tint. It was about 150 millions of square miles in extent (as was also the space enclosed within the oval ring seen by Professor Mayer). The greater axis of the oval was nearly three times as long as the shorter, but part of the difference was due to foreshortening. From a study of several hundred pictures I am led to conclude that the greater axis of the spot was not more than $2\frac{1}{2}$ times longer than the shorter axis. Observations made by the late Professor H. Draper with the spectroscope seem to suggest that the light of the ruddy spot was in part inherent; but others question whether the evidence accepted by Professor Draper was altogether valid. The spot continued visible, with little change of form or colour for about six years, after which time, though it remained visible, it lost its symmetry of form and its characteristic ruddy tint. It was half-veiled for a time (at least in appearance) by the extension of a cloud belt lying north of it, as though this cloud belt lying at a higher level had spread farther and farther over the spot. At present the spot, or rather the traces of the spot, can still be seen; but it no longer presents any of the features, except enormous extension, which made it so remarkable a feature of the planet from 1876 to 1882.

It was noteworthy that compared with the equatorial markings on Jupiter the great spot seemed to lag, as if the equatorial cloud belt were whirled round in a shorter time than the side zone on which the spot was seen.

The first point to be noticed, in this remarkable phenomenon, appears to me to be that which the eye first recognises, the symmetrical shape which the spot presented. Of course the spot was less symmetrical when seen with high powers than when observed with a small telescope; but the symmetry of shape was none the less remarkable that it belonged to the spot as a whole rather than to the spot when minutely examined and largely magnified.

Of course symmetry of form implies, in such a case, uniformity in the action of the forces at work in determining form,—in this case, uniformity in the action by which the spot was produced. The path along which a projectile travels is uniform, apart from atmospheric resistance, because a uniform force is at work on the missile from the beginning to the end of its career. The action on the projectile is along lines always parallel and vertical; consequently the symmetry of the path is related to the vertical: a vertical line divides the path into two portions perfectly resembling each other. Again, the course of a planet round the sun, or of a ball swung round a centre, is symmetrical, because of the uniformity of the forces directed towards the centre. In one case the path is elliptical, in the other the path is circular, but in each case the central nature of the forces at work on the moving body tend to make the path symmetrical with reference not to a line but to a centre. Again, observe a whirlpool, a tornado, the shapes of the clouds seen around a volcanic crater during eruption, and even

the rounded forms of summer clouds, and we see in each case how tendencies towards or from a centre result in giving uniformity of shape to the aggregation of matter resulting from such tendencies. The existence of a shape centrally symmetrical, whether circular or elliptical, implies in every case the existence of forces tending either from or towards a centre. I know of no exception to this rule in nature, though of course artificial productions may show symmetrical forms without giving evidence of central forces.

We may assume then that whatever were the forces at work in forming and maintaining the great red spot on Jupiter, they were related in some way to the centre of the oval region affected by them. They may have produced motion from that centre, or motion towards it, or there may have been movements of both sorts: but assuredly central forces were at work in some way or ways, where the great red spot was formed.

While the symmetry of the spot's shape forces on us this general conclusion, the greater length of the spot in one direction than in another possesses also a special significance.

(*To be continued.*)

THOUGHT AND LANGUAGE.

By Ada S. Ballin.

XIV.

I HAVE spoken at considerable length of the deaf and dumb, a class shut off from the use of articulate speech by physical inability, which may, to a certain extent, be overcome by long years of patient teaching on the oral system, but I have now to speak of a class of unfortunates who, although by no means idiotic, are, through brain disease, deprived of the use of verbal language. In this class I do not include those cases where the power of using language is lost, but that of understanding it is retained, or such cases as the following, mentioned by the late Sir Benjamin Brodie—the case of a gentleman, who, two years after an apoplectic stroke, suddenly lost the power of speaking and of understanding articulate speech, while still able to read and write. A letter read to him conveyed no ideas to his mind, but if he read it himself he understood it perfectly. He recovered from this attack, but had a similar one afterwards. Although these are of great interest from a pathological point of view, they do not imply loss of control over language as such.

In the understanding and production of language many brain centres are implicated,* but its intelligent use is dependent on a comparatively small cerebral area, namely, the posterior half of the third frontal convolution, as it is called Broca's Convolution, and especially that of the left hemisphere. This is supported by the fact that some degree of right-side paralysis generally co-exists with the affection of the faculty of speech by brain disease. Movements of the right side of the body are dependent on action of the left side of the brain, and the development of the left hemisphere corresponds to the superior activity of the right hand over that of the left. In the comparatively rare cases of left-handed persons the right side of the brain has attained the higher development, and in these cases when left-side paralysis co-exists with injury to the faculty of speech *post-mortem* examination reveals damage to Broca's Convolution on the right side. Injury to the brain-centres on which language depends may exist in any degree of severity, from mere functional affection to total destruction, and speech is correspondingly impaired or lost.

Case 1. An interesting case has been recorded by Dr. Banks,* in which a gentleman, aged about seventy-five, suddenly lost all power of understanding what was spoken by others, and retained but a slight ability to understand written or printed matter. He could not himself use words intelligibly. *It was impossible to get him to understand anything*, and his meaning could only be guessed at by his gestures; and the very few words he retained were generally misapplied. Wishing to inform his medical attendant, Dr. Kidd, that his bottle of liniment was nearly empty, he said, "Bring the cord;" at another time he spoke of the pills he had been taking as "potatoes." One day, when giving his waistcoat to be put away, with his watch in the pocket, he said: "Take care of the break-fall." He was quite deaf. His powers of speaking and writing varied at different times; the letters sometimes containing properly-written words, but being almost unintelligible. He wrote his address several times on different sheets of paper, but some of the words were imperfect. "My dear sir" was written correctly, but the sheet was filled with meaningless writing, only the one word, "wife," being legible until the signature, which was in his usual hand. An indication that his intelligence was fairly retained is given by the fact that at the time when a remittance was due from his agent he was much excited every morning, asking often for something. At last it occurred to one of the family to show him his agent's letter. This pleased him; but he was not quite satisfied until the money was brought and counted in his presence. Some shillings were not shown him at first, but when he saw them he seemed to know all was right.

Case 2.—A much more severe case is related by Dr. Broadbent† of a painter, aged 42. His speech was a mere jabber, in which "Ma" and "Mum" were prominent; it was accompanied with excessive gesticulation, smiles, and facial expression. He seemed not to recognise the state of his speech, for he continued to jabber as if he thought he was understood; but he also made signs. "The gestures," said the doctor, "were very striking, when we had a key to their meaning. . . . It was stated that he said 'Yes' or 'No,' and 'Oh, my!' at times; but he did not use even these simple words before us." He could not write intelligibly, nor even copy his own signature. He did not understand what was said to him, and repeatedly put out his tongue when told to close his eyes; but imitated the desired act after Dr. Felce.

Case 3.—Trousseau mentions the case of a lady who was very rational in her actions, but used words quite irrelevantly without perceiving it. She rose courteously to receive a visitor, and, pointing to a chair, said, "Cochon, animal, fichu bête!" which her son-in-law explained by saying, "Madame vous invite à vous asseoir."

Case 4. A striking case of complete loss of control over language, with retention of the power of understanding it and of intelligence as shown by actions and gestures, is that of M. X——, recorded by Trousseau, who

* The physiology of the subject is fully treated in Dr. Bastian's work, "The Brain as an Organ of Mind."

* *Dublin Quarterly Journal of Medical Science*, February, 1865, p. 78. I number the cases quoted here to facilitate the references which will be made to them in the succeeding article.

† *Medico-Chirurgical Transactions*, 1872, p. 170.

saw the patient some months after an apoplectic stroke. He says: "His face was intelligent, cheerful, and full of benevolence. He seemed by his gestures, and especially by the expression of his face, pleased to see me." He could only utter, in a faltering voice, unintelligible words in which "*Yes*" was frequently repeated. To all questions he answered "*Yes*," even when he shook his head in denial;* but he made an impatient gesture, and looked annoyed when it was wrongly applied, while appearing pleased when it was properly used. At dinner he ate with his left hand, not having recovered the use of the right, but ate with propriety, and looked after his guests, taking part in some of the conversation, as for instance, when the lamb of the country was praised he nodded assent, while he shook his head disapprovingly when one of them said the kid was a better flavour than the lamb. He signed to the servants to hand the wine, and when it was of an esteemed vintage indicated that it should be drunk in preference to the others. He played "All Fours" with as much skill as ever, sometimes sacrificing a card to improve his game; and, although his son managed his affairs, insisted on being consulted about his leases, contracts, &c., indicating by gestures when certain parts of the deeds displeased him, and not appearing satisfied until alterations were made which, as a rule, were useful and reasonable. His sight was good, but he could neither read nor write, nor even put letters of the alphabet together; he listened, however, with pleasure to reading aloud. He told his age, fifty-seven, in a complicated way on his fingers. Once he dropped his handkerchief, and when a lady picked it up, uttered the word "*thanks!*" loudly and distinctly; but, though entreated to say the word again, he could never succeed, and could not even repeat the simplest sound which had been uttered before him. I look upon the pronunciation of the word *thanks!* in that case as a mere emotional gesture; a cultivated gentleman like the patient, if in possession of speech, would, in the above circumstances, utter that word spontaneously and without thought; from much use it becomes wholly automatic, and is, I believe, produced by the stimulus of a slight act of courtesy, without that stimulus necessarily reaching the higher centres of the brain. In the case of M. X., the stimulus was a very strong one on the occasion mentioned, owing to the fact that it was a lady who restored his handkerchief, and he would naturally have been unwilling that she should have troubled to stoop for it. Dr. Bazire, the translator and editor of Trousseau's "Clinical Lectures," from which the above case is taken, adds to it one which occurred in his own practice—a case of much greater severity, as it was accompanied by considerable mental impairment; it is particularly noticeable that the gestures performed by this patient lacked the clearness which characterised those of M. X.; their defects having been caused by a more serious injury to the brain. She, however, at once understood the gestures of others, and her condition regarding gestures may be compared to that of M. X. with regard to words which he could understand, although unable to use them.

Case 5. Three months before Dr. Bazire saw her, M. W. was attacked with paralysis of the right side; she dropped senseless, and on recovering her senses could utter nothing but "Sapon, Sapon," which from that time she continually repeated. "*She could not be made to understand at once by words alone what was required of her; and could not always answer correctly by gestures the questions which she was asked. Her pantomime was not so clear as that of a deaf and dumb individual, and she seemed not to be able to understand the meaning of words. They had to be spoken very slowly and repeated several times before she could catch their meaning, and she most frequently failed completely in this. Gestures she understood at once. Thus when I asked her to show me her tongue, she did not always do so immediately; but on putting out my own tongue, and then making signs for her to do the same, she instantly complied. . . . She held her pen properly (with the left hand), but only made a meaningless scrawl. Although she kept constantly repeating 'Sapon, sapon,' I could never make her say 'sap' or 'pon' by itself, or repeat any syllable or word after me.* She knew her own name, and when I mentioned it, she laughed and pointed to herself. According to her sister's statement, she remembered localities and knew faces well." Nine months afterwards she was somewhat improved, still saying "*Sapon, sapon*"; but could distinctly say *yes* and *no*, although not always using them correctly, and could count *one*, *two*, *three*, *four*. Her sister said that under great excitement she sometimes exclaimed, "Oh, dear me!" a statement which agrees with the hypothesis that emotional expressions are retained as being on a lower level and more anciently ingrained in the race, when words expressive of thought are wholly lost. She could not yet write, though trying hard, nor even recognise the letters of the alphabet. She had still great difficulty in understanding what was said in words, though not at all deaf, but immediately understood gestures. Her own pantomime was still lacking in clearness. She was fond of looking at pictures. I have no clue to the origin of the word "Sapon," the only articulation used by this patient; but generally those words which, owing to great familiarity have become, as it were, ingrained in the mind, are those which are retained. Thus *yes* and *no* are the commonest, although, as above shown, they are not always used correctly. Next to this is the name of the patient and his address.

Case 6.—Thus a patient of Dr. Bastian's, partially paralysed on the right side after severe epileptiform attacks, sixteen days after the seizure could say *Yes* and *No* indistinctly and not appropriately. Nineteen days after that she had added the word "Nurse" to her limited vocabulary—a word which must have been constantly presented to her in the ward of the hospital where she was lying. *She seemed to recognise familiar objects, and know when the right name was given to them*, and to recollect her own name. She did not give signs of recognition when the name of the street she lived in was mentioned, but nodded at once when she heard the remaining part of her address, "Fitzroy-square."

Case 7.—Dr. Samuel West, at a meeting of the Medical Society,* recounted a case of aphasia, with some loss of power and sensation in the right side. The patient, in accordance with the observation made above, retained some words in common use, such as "Good morning," "Yes," "Order," "Corner," "One or two with it"—a phrase he had occasion to use frequently in his occupation as carrier. When attempting to say more his utterance became wholly unintelligible, but occasionally he said "I can't," or "I couldn't." Although understanding the use of visible objects, he could not name them. He made futile attempts to write, and could not read, although he held the paper the right way up. He understood very little that was said to him, but

* A similar case is mentioned by Dr. Bastian, whose patient was utterly unable to speak, although his intelligence was, to all appearance, unimpaired. His only word was "*No*," which he used in answer to all questions, even when he nodded his head in assent.

* January 12, 1885.

would perform certain acts when told to do so, and evidently understood simple questions. He sometimes repeated words spoken before him, but only in automatic mimicry.

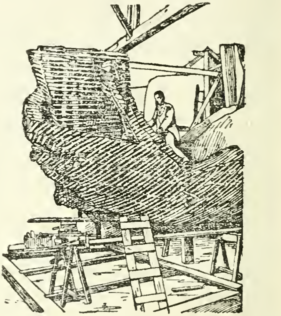
COLOSSAL STATUES.*

BARTHOLDI'S STATUE OF LIBERTY.

UP to the present time no statue had ever been executed of the extraordinary proportions of the Statue of Liberty. In order to form an idea of this work, which was without precedent, it was necessary to give the greatest attention to the means of execution; it was necessary to foresee the elements of solidity and the exigencies of the transportation to America; finally it was necessary to seek to avoid heavy expenses into which one is rapidly drawn in a work of this kind, according to the methods employed. The examination of the various difficulties led us to adopt the system of hammered copper, which from an artistic point of view, offers elements of excellence, when it is well treated, which allows of a large subdivision in the pieces, and renders the transportation easy.

We will examine the various phases of the work. The total height of the first model was 1·25 mètres. This was the study-model, which was long sought and often recast. (It is the model which has been reproduced in terra-cotta, the number of the reproductions being limited to 200. Each model was numbered and registered, and a large number of them were sold in aid of the subscription under the name of the "Model of the Committee.")

After this first study, I made the statue, which measures from the head to the feet 2·8 mètres, and in its entirety 2·85 mètres. This statue, executed with rigid precision, was reproduced four times as large by the ordinary processes. The model which was the result of this work measured about 11 mètres in total height. Placed in a large space, it could be taken in by the eye in its entirety, and the corrections to be made could still be noted. This statue was divided into a large number of sections, destined to be reproduced separately at four times their size. After this last enlargement, changes were no longer possible. Now the sculptor could only aim at very great precision and at great care in the modelling of the surfaces, which were becoming enormous. It was necessary to study them in their simplicity and their nakedness, so that the form should be flowing and correct, without prominent details which would detract from the general appearance. In an immense workshop, specially constructed for the work, were to be seen four plane surfaces on which the work was carried on. They were encompassed with frames, laid out in numbered divisions. Another similar frame, corresponding exactly to the one below, was fastened beneath the ceiling of the workshop. Lead wires and rulers hung all round the frames. On these frames, thus geometrically laid out, the sculptors executed in wood and in plaster enormous fragments of the statue. The sections of the model that they were to reproduce were arranged near by under corresponding conditions, between frames of one-fourth the size. The sculptors executed the enlargement by measurements taken with the compass on the lead wires and the rulers. They first laid out the general form with wooden beams covered with lath-work. The wood was then covered with a coating of plaster. They verified the large measurements already established, and then executed the reproduction point by point, and finished the modelling of the surfaces. Each nail head and point marked requires six measurements, three on the model and three for the enlargement, without counting the verifying measurements. There were in each course about 300 large points and more than 1,200 secondary points, which represented for each course the work of establishing about 9,000 measurements. When a course was finished the carpenters took its forms by means of boards cut in profile, according to the form of the plaster. They were applied on the spot, placed one opposite to another and crossed, thus forming pigeon-holes, larger or smaller. Thus they took a sort of impression. In these wooden moulds or *gabarits*, the hammerers pressed the sheets of copper by pressure, with levers, and by hammering with mallets. The pieces of copper were finished by beating them with little hammers and with rammers. The profile of the forms was again taken in detail with



Wooden frame-work and process of modelling the left hand of the statue in plaster.

sheets of lead, pressed upon the model, again working the copper according to the profiles. The pieces of copper were furnished from point to point with iron braces, intended to give them rigidity. These braces were forged in the form of the copper when the contour of the latter was completely modelled. Thus furnished the pieces were carried to the mounting in the court, to be brought together and fastened on the powerful trusswork of iron beams which serves as support for the whole envelope of the statue. The core of this trusswork is formed by a sort of pylon which has four points of attachment. Each of these points is sustained by three bolted braces, 15 centimètres in diameter, which are made fast at a depth of 8 mètres in the masonry of the foundation to a frame of iron beams. The whole trusswork was designed and executed by the eminent constructing engineer, M. Eiffel.

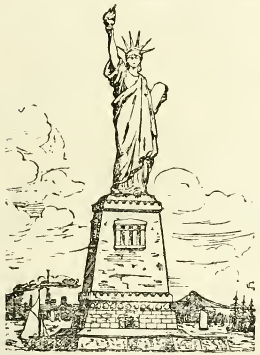
This trusswork serves as a support for the copper form of the statue. The copper plates, kept in shape by iron bands, are supported by iron braces, which are cramped on to the central core. They do not bear in the least

* From the *New York Tribune*.

upon the lower plates, and their weight is always independent of all that is above and below.

Exhaustive mathematical calculations were made upon the resisting power of the iron pieces, upon the centre of gravity and upon the action of high winds. The calculations were made by taking as a base the most powerful hurricanes which have been recorded either in America or in Europe. In regard to the preservation of the work, since all the elements of its construction are everywhere visible on the inside in all their details, it will be easily kept in good condition.

To end this account I ought to add to it a few bits of statistical information, although they have been published on various occasions. The whole work was done in the celebrated house of Gaget, Gauthier & Co., of Paris. The statue is constructed of copper sheets, two and a half millimètres in thickness. It measures 46·08 mètres from the base to the top of the torch, 35·50 mètres from below the plinth to the crown, 34 mètres from the heel to the top of the head.



Statue of Liberty mounted on pedestal, with New York and Brooklyn Bridge in the background.

The forefinger is 2·45 mètres in length, and 1·44 mètres in circumference at the second joint. The nail measures ·35 mètres by ·26 mètres. The head is 4·40 mètres in height. The eye is ·65 mètres in width. The nose is 1·12 mètres in length. About forty persons were accommodated in the head at the Universal Exposition of 1878. It is possible to ascend into the torch above the hand. It will easily hold twelve persons. The total weight is about 200,000 kilos, of which 80,000 are copper and 120,000 iron. It represents an outlay of more than a million francs, including gifts, gratuitous work, and the losses of all those who gave their devoted assistance to the work.

The colossal statues which have been executed up to the present time are far from the proportions of the Statue of Liberty. I have given above some indications on this point. Yet we must not expect its appearance to be colossal when it is in its place. In the immense picture which will surround it it will appear simply in harmony with the whole, and have the normal aspect of a statue in a public place. It should be thus, because its part is not to appear extraordinary in itself, but to connect itself intimately with an extraordinary whole.

The statue was born for this place, which inspired its conception. May God be pleased to bless my efforts and my work, and to crown it with the success, the duration, and the moral influence which it ought to have. I shall be happy to have been able to consecrate the best years of my life to being the interpreter of the noble hearts whose dream has been the realisation of the monument to the French-American Union.

ILLUSIONS OF THE SENSES.

By RICHARD A. PROCTOR.

(*Continued from page* 90.)

I HAD a singular example recently of the effect of position in forcing an illusory idea on the mind, even when the truth was well and even familiarly known. I was in the streets of Charleston (South Carolina) engaged in conversation, but my eyes directed towards the upper ridge of a projecting balcony. While I talked, I saw what looked like a bird's head rising just beyond the ridge, and in a moment or two there was the creature, a tiny but very oddly shaped bird apparently fluttering above the balcony. It looked no larger than a humming-bird. Now I knew at once that I was not looking at a bird, because I could see that the object had a pendent waving tail such as no bird ever had. I knew as well that it was not a small bird close by, but a Chinese kite at a considerable distance, as I knew that it was day; yet because my mind had started with the wrong idea that the object was just above the balcony, I could not for several seconds shake off the absurd impression that there was a miniature bird-kite fluttering above a straight stone ridge where assuredly was no string attached to it. I take it that the deception by which, against my own knowledge, I was for awhile made to imagine the kite much smaller than it really was, because it seemed much nearer than such an object is usually seen, was precisely akin to the illusion by which, against our own knowledge we are led to imagine the moon much enlarged near the horizon because it there seems much farther away than as seen high up towards the zenith.

The illusion as to the shape of the heavens around us and the sky above us (not the same thing be it noticed) is one which deceives us all the time,—at least, I have never met with anyone who has been able to correct either form of illusion. We conceive the heavenly bodies overhead to be nearer to us than those near the horizon, the heavenly concave being presented as somewhat flattened overhead: and on the other hand a cloud-covered sky appears arched overhead instead of having a flat horizontal surface. Do what we will we cannot force the mind to feel either that the stars overhead are no nearer than those by the horizon, or that the clouds near the horizon are as much farther away than those overhead, as they really are. The clouds low down seem somewhat farther away than those above our heads,—perhaps four or five times farther: but in reality they are usually twenty or thirty times farther from us. But the mind refuses to present to us the much greater distance of those low-lying clouds.

It may be said indeed that the mind is unable to conceive a spherical surface, either convex or concave, beyond

a certain size which differs probably in the case of each person, differs certainly as life advances, and is far short of the dimensions of any one of the celestial globes, except possibly the moons of Mars. It may be that if living in Fear or Terror (as the attendants on Mars have been called) we might recognise the rotundity of the surface of our home, seeing that probably neither of these moons has a diameter of more than twenty miles. But it is certain that no one can appreciate the rotundity of our earth, in such sort that not merely the circumstance that the globe is rotund is recognised, but the dimensions of the globe of which the region we see at any moment is a part. The best proof of this is found in the fact that the earth's surface appears concave so soon as we see any very large extent of it. As seen from a balloon, for instance, the earth seems like a gigantic basin, the mind not being able to take in the real truth that the earth is too large for the horizon to dip recognisably even when the eye is two or three miles above the earth's surface. If one could pass away from the earth to distances so great that she would be visible as a globe, we should still be unable to form any idea of her size,—just as now the sun, moon, planets, and stars tell the eye nothing of their real dimensions.

A curious question here suggests itself:—Supposing one could pass away from the earth's surface steadily till she appeared like a globe, what would be the changes her aspect would undergo? She would certainly appear concave until a great height had been attained; and as certainly she would eventually appear a globe as the sun and moon do: but in what way, I wonder, would the apparently concave surface pass to a manifestly convex surface? Would this happen gradually, or would the conviction suddenly force itself on the mind that the surface which had appeared concave was really convex? There is a familiar illusion which illustrates such a change as this, and seems to suggest that the change of appearance would be sudden. If you look through a lens, inverting the object seen, at a convex surface, it appears to be concave (a coin under the same conditions appears to have all the parts which are really in relief depressed) because the mind recognises the evidence given by the shadows without being conscious that this evidence has been inverted by the action of the lens. Now if, while the convex surface thus appears concave you introduce into the field of view some object which shows which way the shadows really fall—as an upright pin, or the like—you find the seeming concavity at once changed to convexity, the mind being unable to note how the change takes place, so rapid is it. Possibly this would be the way in which the seeming concavity of the earth would change to convexity, as we passed away to the distances at which the earth would appear like a celestial orb.

Illusions affecting our ideas about the apparent brightness of objects are even more deceptive than those affecting form. The French astronomer Chacornac wrote an article once in explanation of the superior brightness of the discs of Jupiter and Saturn near the edge. The explanation was ingenious, and would have perhaps thrown light on the nature and condition of the giant planets, if it had only chanced that the superior brightness which he explained had a real existence. As a matter of fact, however, so far are the parts of Jupiter and Saturn near the edge of their discs from being brighter than the parts near the middle, that the precise reverse is the case, and in quite a marked degree. I was first led to observe this by theoretical considerations, which seemed to suggest that the light from the parts of Jupiter near the edge ought to be very much less than the light from the middle of the planet's disc. It so chanced that just as I had satisfactorily reasoned this out, I came across Chacornac's article explaining why the edge is so much and so obviously brighter than the middle. This led me to inquire whether the case really were as he supposed or not. Now, to those who have paid attention to the phenomena of Jupiter's satellites, many circumstances are known which show that the edge of Jupiter's disc must be darker than the middle. For example, a satellite looks light when near the edge, dark when on the middle of the disc; or else, (which proves the same thing) a satellite is scarcely visible near the edge, being so nearly of the same lustre as the planet, but as it passes on to the brighter central parts of the disc it becomes a dark spot, sometimes even looking as dark as its own shadow close alongside. All this in reality proves that the edge is darker than the middle of the disc; yet it looks decidedly brighter. I suggested, therefore, to a friend who was making experiments on the luminosity of various celestial bodies, that he should test this matter by determining whether the parts of Jupiter's disc near the edge or the parts near the middle remained longest visible when the light of the planet was gradually extinguished by means of a neutral-tinted darkening glass (graduated from almost complete transparency at one hand to almost complete opacity at the other). The result was decisive, and exactly contrary to the evidence of the eyes. The parts which to the eye seemed so obviously the brightest were the first to yield to the absorption of the light, the parts which looked least bright remained visible longest. Of course, the illusion is easily explained. By contrast with the black background of the sky the parts near the edge of Jupiter and Saturn look brighter than they really are.

A noteworthy illusion was passingly indicated in what I have just described. I have said that a satellite sometimes looks as dark as its shadow close alongside. Now the shadows of the satellites look black; but the satellite itself cannot be black. We see then that the appearance of blackness does not necessarily imply real blackness. So the spots on the sun look black near the middle of the umbra; yet they cannot be really black there; and indeed when examined so that the effect of contrast is avoided they are found to emit a considerable amount of light. Another case of illusion may be noticed in total eclipses of the sun. Here the body of the moon looks black; yet in reality it is lit up at least twelve times as brightly as a landscape under full moonlight, for the earth is at the time of solar eclipse shining full upon the half of the moon turned earthwards, and her disc is $13\frac{1}{2}$ times as large as the moon's appears to us. To my mind, one of the best proofs of the brightness of the solar corona, is found in the seeming blackness of the moon's disc during total solar eclipse.

But the seeming whiteness of the moon's disc when she is full is quite as much an illusion as its seeming blackness when she is between the sun and us. For the moon is not really white. She is much more nearly black. Regarding 100 as representing perfect whiteness, the average tint of the moon's surface would be represented by only 17. Probably the darker portions, which, when she is full look only slightly less white than the rest, are as dark as our porphyries and syenites.

Another remarkable illusion affecting brightness is that which has deceived several students of the moon in the case of the floor of the lunar crater, Plato. This broad expanse seems to grow darker as the sun rises higher above its level; but this is a pure illusion, due to the gradual diminution of the black shadows of the sur-

rounding mountains. By contrast with these shadows the floor looks lighter than it really is; as they diminish it seems to grow darker; when they disappear altogether it looks darkest; and as they gradually grow larger in the afternoon and evening of the long lunar day there, the floor seems to get light again. As a matter of fact the floor gets brighter as the sun rises higher above its level, and darkens again as the sun gradually nears the horizon of Plato.

The illusions affecting motion are too remarkable and too numerous to be dealt with properly in the small space remaining to me here. I may perhaps consider them hereafter in a separate short essay.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

COLEOPTERA (*continued*).

We conclude our notice of the family *Tenebrionidæ* with the creatures called "mealworms," which are the larvæ of two species of beetles, *Tenebrio molitor* and *T. obscurus*. Both larvæ and perfect insects are found in granaries, flour-mills, and bakehouses, where they sometimes do much damage to meal, bran, and flour. The larvæ are much more familiar objects than the imagos, though probably the reverse is the case with the rest of the family. They are used as food for certain singing-birds and other insectivorous creatures, and hence are bred in large numbers by bird-fanciers. This may readily be done by keeping them in bran, when they will propagate themselves freely. The word *Tenebrio* is Latin for a night-walker, or lover of darkness, and so far as the mere meaning is concerned, the name would be just as applicable to the rest of the family as to the present insects, the whole set being devotees of obscurity. *Molitor* is Latin for a grinder of corn, and *obscurus* finds its explanation in the dull appearance of the second species.

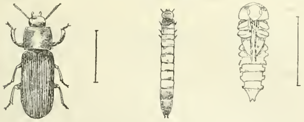


Fig. 1.—A, Tenebrio molitor; B, larva of ditto (natural size); C, pupa of ditto.

T. molitor (Fig. 1, A) is a narrow, parallel-sided beetle, a little over half-an-inch in length. Above it is almost black, the faintest possible tinge of a dark brown-red preventing it from being quite so; or perhaps it might be more correctly described as deep brown-red, so deep as to appear almost black; beneath and in the legs the lighter colour is much more apparent. It is slightly shiny, but only just sufficiently so to be redeemed from the utter dulness and dinginess which characterise its relative *T. obscurus*. Down the elytra run the inevitable parallel furrows, sixteen in number, not deep, but distinct enough to form a little "set-off" to the otherwise uninteresting appearance. The front of the head forms a ridge, which, as in some other species previously referred to, encroaches considerably on the eyes. The legs are rather short, and the antennæ are inelegant, thick, and stumpy. Unlike *Blaps*, it is furnished with wings, and therefore, of course, the elytra are not soldered together.

T. obscurus is a trifle larger than *T. molitor*, perfectly dull black above, without a trace of the red-brown tint, which, however, appears again on the under side; in other respects it is almost the exact counterpart of its slightly less inelegant congener.

Such are the parents of our mealworms; the "worms" themselves are as different as can well be imagined — long, narrow, cylindrical, caterpillar-like creatures (Fig. 1 B), consisting of a head and twelve similar and perfectly distinct segments. The colour is pale yellow, shading off into yellowish-brown towards the head and tail. Each segment at its hinder edge carries a rather broad band, and at its front edge an exceedingly narrow one, of the darker colour, so that the body is adorned with a series of double rings encircling it at intervals along its length. The last segment is rounded behind, and terminates on its upper surface in either one or two small black curved hooks. The head is furnished with a pair of not very large, but nevertheless strong, dark brown jaws, which, in repose, close in between the upper and lower lips, so that only their outer edges are seen. There are also a pair of tiny antennæ.

Under the three segments immediately succeeding the head are three pairs of short legs, each terminating in a sharp curved claw. By means of these the "worm" is able to progress at a tolerably rapid rate, provided there are sufficient irregularities in the surface to afford foothold to its tiny claws; but if transferred to a polished surface it presents a ludicrous spectacle; the front part of the body makes mighty efforts, struggling vigorously with its legs, and twisting itself from side to side, in vain endeavours to stir the inert mass of legless body which acts like a drag behind. The two legs in each pair are moved forward simultaneously, and the order of movement, which is not always quite uniform, and is extremely difficult to follow, appears generally to be first the front pair, then the third, and lastly the second. As the insect walks along, that part of the body immediately over the legs is, of course, somewhat raised, but the head is kept near the ground, so that it may feel its way with vibrating antennæ and palpi. When walking slowly, or endeavouring to extricate itself from a difficult position, it also makes use of a pair of fleshy tubercles underneath the front part of the terminal segment, thereby either helping the hinder part of the body forward, or acquiring leverage for the proper action of the legs. But when trotting briskly along there seems to be no necessity to call these tubercles into play, and the hinder part of the body therefore simply trails helplessly over the ground.

When fully grown the larva is nearly double as long as the beetle it produces, but what the latter loses in length it gains in breadth, as it is fully twice as broad as its ancestral worm. Having spent some months in devouring farinaceous substances, and changed its skin several times during that period, the "worm" enters its penultimate stage by another moult, but without forming any cocoon. It is now shorter and broader (Fig. 1. C), no longer a roving pirate, but a restful, helpless mummy, giving prophetic indications of its future destiny in its altered form—a beetle to all intents and purposes, but a caged and helpless one. After a few weeks the needful changes in its internal economy have been accomplished; it throws off its last skin, and appears a fully-developed winged beetle, at first soft and red, but destined soon to

acquire its natural firmness and pitchy colour. Previous to every moult, the mealworm acquires a bloated appearance, and becomes inactive for a time, lying on its side in a curved position, and resenting all interference with petulant twitchings of its form.

These mealworms will attack bread, cakes, &c., as well as uncooked cereals, and they have also been accused of devouring corks.

When we remember how many different species of "corn-loving" beetles occur in our corn-stores, and how excessively abundant some of them are, we are forced to the conclusion that many must often be ground up with the flour, and that we, therefore, sometimes get our bread adulterated with pulverised beetles, and unconsciously become "insectarians" for the nonce. But "what the eye does not see, the heart does not grieve over," and possibly we may not really be any the worse for this slight admixture of animal matter with our farinaceous diet, though there are not wanting those who have thought otherwise. Many of these "corn-lovers" are Heteromera, as we have seen, and to this section belongs also the blister-beetle renowned in medicine, and no very distant connection of our *Tenebrios*. Moreover, a Brazilian species of *Tenebrio* is known to eject from its body a caustic secretion, and some other allied insects cover themselves with a similar substance. Now if our mealworms, &c., have properties at all analogous to those of Spanish Fly, this internal application of cantharides, even in homœopathic doses, might not, perhaps, be altogether desirable. Some, too, have supposed the celebrated corn-weevils to be prejudicial to health when in a comminuted state.

Flour is not the only article of food that is liable to adulteration in this way. Curtis, in his "Farm Insects," has the following uncomfortable and suggestive passage: "I have known bushels of cocoa-nuts (*i.e.*, of course *cacao*) which were every one worm-eaten and full of maggots, with their webs, excrement, cast-off skins, pupæ, and cocoons, all ground down to make chocolate, flavoured, I suppose, with vanilla."

(*To be continued.*)

THE YOUNG ELECTRICIAN.

By W. Slingo.

(*Continued from p. 48.*)

Ex. XCV.—The form of rubber referred to in the preceding example is that pictured in Fig. 51,

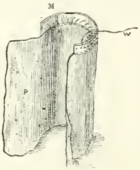


Fig. 51.

which consists of a pad, P, composed of a few layers of silk, large enough to surround the glass tube upon which the rubber is to be used. Along one edge of the pad a strip of thin brass or other metal, M, is stitched, and in it are pierced a number of small holes, the point of a pin being inserted and soldered into each hole. The points should all turn inwards, so as to pass close to the surface of the glass tube as the rubber moves along it. A piece of wire, W, is attached at one end to M; the other end being placed in the sand (Fig. 50), or wherever else the charge may be required.

Ex. XCVI.—Another kindred experiment is to suspend a pith ball from the support illustrated in Fig. 36 or Fig. 47, by means of a piece of silk thread or fibre. The approach of an electrified glass-tube results in the attraction of the pith-ball, which, coming into contact with the glass, becomes similarly electrified, and is consequently repelled. Although repelled by the glass, it will be energetically attracted by an electrified stick of sealing-wax. After contact with the wax, the electrification of the ball will be reversed, repulsion will set in, and the glass will next attract the pith-ball.

INDUCTION.

Pr. 4.—By induction is meant the electrification of a body by the influence of another body already electrified, near, but not in contact with it.

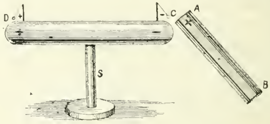


Fig. 52.

Ex. XCVII.—In Fig. 52 A B is a glass tube, of which the end A has been electrified and placed near the conducting body C D, which may be the orthodox brass cylinder with rounded ends, although it may be constructed in a much less elaborate fashion. Take half a sheet of foolscap paper, and make a rigid tube with it. To do this, procure a large ruler, or other round rod, an inch or more (two inches is a good size) in diameter, and roll the paper round the rod once; pull tight, and cover the upper surface of the remainder of the paper with flour paste, glue, or preferably with gum. Then wind the whole of the paper on to the rod or ruler, pulling it as tight as possible. Bind up the paper with string, and lay aside till the gum is dry, when the string may be unwound, and a first-class rigid tube will result. Provide the tube with rounded ends. A wooden ball (such as is procurable at a toy-shop) cut in half will answer this purpose very well, so also will a couple of tolerably round egg-shells.

Or a solid wooden cylinder may be procured, the main features being that the sides shall be parallel, free from edges, ridges, or points, and the ends rounded.

The cylinder being produced, it requires a conducting surface, which may be imparted by coating it with tinfoil. This is easily done, tin being a very soft and ductile metal, and tolerably porous. Before being applied, the foil should be well smoothed, which may be done by rubbing it with any round body, such as a chisel-handle. This being done, and pieces of the requisite size and shape being cut off, the cylinder may be coated by a good application of flour paste, a little gentle pressure being all that is necessary to ensure the adhesion of the foil to the wood or paper (whichever may be employed). The

support, S, is made by fitting a half-inch glass tubing, well dried, into a wooden base, the upper end being closed with a cork or wooden plug, well dried, and fitted with marine glue, sealing-wax, pitch, &c. A headless pin or a needle driven into the plug furnishes a means for supporting the paper or wooden cylinder, C D. Near each end of the cylinder is a small support (a miniature of that depicted in Fig. 47), made from a piece of brass wire, and carrying a small pith ball, suspended by a piece of cotton thread. To ensure insulation it is advisable to close the bottom of the glass support by a plug fitted with sealing-wax, &c. The outer surface of the tube should also be painted or coated with a thin, even layer of shellac varnish (Ex. I.).

On the approach of the positively electrified rood A B, C D becomes electrified by induction, the near end C becoming negative (or opposite to the charge on A) and the remote end D becoming positive (similar to A). The pith balls take up the positions shown because they are charged similarly to the respectively adjacent ends of the cylinder and wire supports. Repulsion ensues from this. The ball at C also shares the attraction of A. On removing A B, C D relapses into its normal unelectrified state, and the balls again fall into the vertical position. This demonstrates that A B imparted none of its charge to C D.

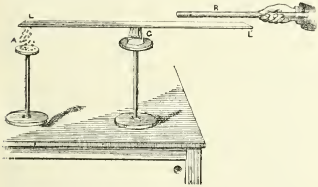


Fig. 53.

Ex. XCVIII.—We can show induction in another way. Hold an electrified rod, R (Fig. 53) over the end L′ of a wooden lath LL′ (Ex. LXXIII.), supported on an inverted tumbler, G, resting on any convenient support. The tumbler should be previously thoroughly warmed and dried for insulatory purposes. A is another support, uninsulated, and carrying a small quantity of bran, paper-clippings, gold-leaf fragments, &c. These substances are placed under the remote end L of the lath, and, on the approach of R, they are attracted by the lath. If R is positively charged, so also is L; the small pieces of paper, &c., become first charged by induction exerted by this charge at L; then they are attracted to L in consequence of their present negatively-charged surfaces; they come in contact with L, and consequently, becoming also positively electrified; they are therefore repelled; they in their repulsion induce an additional negative charge on A, come in contact with A, and become neutralised, when they are ready to be again inductively electrified and attracted by L. In this way, the paper particles are kept moving up and down between A and L until that end of the lath is discharged, *i.e.*, contains no more positive electricity. When this occurs, L ceases to attract the paper. If then R is withdrawn, the negative charge concentrated at L′ diffuses itself over the lath, and attraction, although feebler than before, is again exerted by L upon the paper.

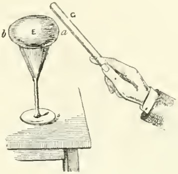


Fig. 54.

Ex. XCIX.—In Fig. 54 is shown another experiment of a somewhat similar character. E is an egg (an apple, a pared carrot, parsnip, turnip, potato, &c., will answer equally well); this is placed on a dry, warm wine-glass or other insulating support. The electrified rod, G, is brought near the end *a* of the egg. Induction ensues, and the two ends of the egg become oppositely electrified. If the finger be placed at the end *b*, it will practically remove that end of the egg to an infinite distance, when only one kind of electricity will remain, namely, that located at *a*. If, now, the finger is removed, and then G, E will be found to be electrified and capable of attracting light bodies, such as the suspended pith ball, &c. Of course, neither the finger nor any other conductor should be allowed to touch the egg, or it will be discharged.

HYSTERIA AS RELIGION.

An Indiana journal has a long account of the strange doings of a so-called female evangelist who is going through the country holding revival meetings in which alleged "trances" figure conspicuously. It is complained by sober-minded and observing professors of religion that the effects of these revivals are evanescent, and that in fact the excitement passes as rapidly as it comes. The ministry have been accused of jealousy of these meetings and the leaders of them, but the general disapproval entertained toward such methods by thinking pastors rests upon far higher grounds.

Medical science does not hesitate to assign the methods here used for religious purposes to the category of diseases. The kind of trances into which the Indiana evangelist falls is not mysterious to the student of medicine. He recognises it as one of the manifestations of the many-sided disease called hysteria. And in the epidemic character of the emotional outbursts at such revival meetings the influence of similar abnormal conditions is perceived.

To the physician's apprehension there is in these violent physical phenomena no question of mental conviction or conversion, no evidence of any intellectual process whatever; but solely and simply an involuntary and irrational nervous convulsion, propagated by contagion, truly epidemic in its character, and inviting treatment by medicine like any other physical complaint. The epidemic character of such outbreaks has indeed been conclusively established. The precise aspects of the epidemic may be determined by almost any trivial external incident, and it depends upon something of this

kind whether the victims shall all mew like cats, as did a whole convent full of nuns in Italy, or imagine themselves monkeys, and try to climb the pillars of the churches, as happened to congregations in Ireland, or shout "Glory!" and roll on the ground, as do the negro ecstatics at Southern revivals.

The Convulsionaries of St. Medard belonged in the same category. They were seized with a furious desire to be beaten, and so transported were they by their hallucinations that they actually endured the most violent blows, not only without sustaining permanent injury, but without showing the least external lesion. In the Irish epidemic, half a century ago, the people of whole parishes were affected, and it was observed that when those who passed from an infected village to one which had previously escaped, the epidemic was spread by contagion, just as a zymotic disease might have been.

In revivals this element of contagion is very powerful, and this is one of the most marked characteristics of hysteria. Merely looking at a person in a convulsion will often throw sensitive persons into a precisely similar state. The phenomena, however, have nothing to do with the will or the understanding. They are physical, not mental, and it is for this reason that they do not produce any permanent effects. The common experience of lay observers respecting the after effects of spasmodic revival meetings is simply a confirmation of the scientific conclusions. The evangelists who operate by means of trances and exciting the emotions of their hearers powerfully often produce very striking effects, but cannot expect any lasting changes in their subjects.

There is mischief in the delusion which confounds hysteria with religion, for the consequences of this mistake are of a kind to disgust sober and rational people, while they afford opportunity for ridicule to unbelievers, and disturb and expose to bad influences the weak men and women who accept them for what they are not. A little sound education in physiology and the elements of medical science would dissipate the hallucination that the evidences of diseased condition are analogous with the proofs of religious conviction.—*New York Tribune.*

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

XIV.—THE SEBACEOUS FOLLICLES—EIDER-DOWN.

THERE is one more function of clothing which I suspect is better performed by flannel than by any other clothing material, though I can only supply speculative reasons for this conclusion; direct experiment is wanting.

Besides the glandular apparatus for secreting the sweat, the skin and subjacent tissue contain other glands or follicles, in which hairs and feathers are elaborated from material supplied by the blood. To the sides of these glandular hair-producing sheaths are attached by a little tube or "duct" the *sebaceous follicles* which secrete an oily liquid that is poured into the subcutaneous hair-sheath by means of the ducts. This apparatus lubricates the hair and the quill portion of the feather by supplying a natural soapy pomade, which is rather abundant in some animals, notably the sheep whose wool is very greasy, or I may say soapy, as the "yolk" or "suint" with which it is so largely supplied is partially saponified by potash. The oldest of living chemists, the centenarian Chevreul, published in 1828, an analysis of raw merino wool, in which he found:—

Pure wool	31·23	per cent.
Soluble suint	32·74	"
Insoluble suint	8·56	"
Earthy matter	27·46	"

This is a maximum quantity. Some other wools contain but 10 or 12 per cent. In all cases the quantity is considerable. At present there are works at Rheims, Elbœuf, Fourmier, and Vervier that extract annually about 1,000 tons of carbonate of potash from raw wool, besides the fats. Our manufacturers shamefully waste this product, especially now that by means of bisulphide of carbon it may be so cheaply and profitably removed.

The lubricating of the hair is the function usually ascribed to the sebaceous follicles. Assuming this to be correct, we come upon a curious anomaly in the structure of the human body. We there find sebaceous follicles more fully developed at the roots of certain very minute downy hairs than at those of the stouter and longer hairs. I shall be quite in the fashion of the day if I plunge at once into evolutionary speculation concerning these, by describing them as "survivals" of the once luxurious fur of our remote ancestors; and ascribing the special luxuriance of sebaceous follicles on our noses, above, behind, and by the sides of the nostrils, to the former development of cat-like whiskers thereabouts.

Be this as it may, our noses become greasy in hot weather; other parts of the body also, and the greasy secretion, not being carried forward by the hair, rests upon the skin, attaches to itself dust particles, &c., forming a varnish that is unpleasant to contemplate, and presumably mischievous, if not removed. Besides this, an interesting and disagreeable microscopic object is liable to be hatched and nourished amid the neglected secretions of these sebaceous follicles. This is a large-bodied creature, with eight short legs projecting from the fore part, and bearing the name of *acarus folliculorum*, alias *demodex folliculorum*, alias *entozoon folliculorum.*

That the removal of this greasy secretion is better performed by the contact of woollen fibres than by those of linen or cotton is, I think, presumably proved by the facts above described concerning suint, and the experience of manufacturers of woollen fabrics; that of the fuller especially.

My admiration of Rumford and his work must not stand in the way of impartial criticism. Applying this to his experiments on the relative heat-resisting properties of various clothing materials (see No. 6), a weak point becomes evident. He packed the sixteen grains of the different clothing materials uniformly into the same space around the bulb of his passage thermometer. This was desirable at first, when his object was to determine the relative conducting power of the materials themselves, but after he had by these experiments discovered that it was not the resistance of the fibres themselves to the passage of heat, but that of the air which they imprisoned, a further question was presented, which still remains unanswered, viz., How much of this non-conducting air can a given quantity of each of these fibres respectively grasp and hold entangled with a sufficient grip to check the convection currents whereby alone the gaseous matter carries heat?

Besides this, the experiments, in order to become strictly representative and practical, should be so conducted as to leave the fibres or the fabric externally exposed to the air rather than enclosed in the glass globe surrounding the bulb of the passage thermometer.

When I can find time and opportunity I hope to carry

forward some experiments commenced many years ago with thermometers having long cylindrical bulbs of equal dimensions representing the body of a clothes-wearer. These bulbs are clothed with properly-fitted jackets of the different materials; all raised to a given temperature in a hot chamber, then set to cool down in a cold chamber, and their rates of cooling observed and recorded.

With Rumford's arrangement, eider-down took second place in total time of cooling. (Hare's fur, 1,315 secs.; eider down, 1,305; beaver's fur, 1,296; raw silk, 1,284; sheep's wool, 1,118; cotton wool, 1,046; fine lint, 1,032.) The spun and woven fabrics, as will be remembered, yielded larger advantage to woollen material, and all were much inferior to the raw material.

Among the raw materials above enumerated, only eider down is practically used for clothing in its raw state. It thus takes *practically* the first place, under Rumford's mode of testing it. But this method does not do justice to eider down, as it destroys its specially efficient attribute. To make sixteen grains of eider down occupy the same space as the sixteen grains of other material it must have been considerably rammed—squeezed, into a much smaller bulk than it spontaneously occupies. Had it been allowed to occupy its full bulk, it would have imprisoned a much larger quantity of air, and consequently have achieved a much greater resistance to the passage of heat.

I have no hesitation in affirming that, weight for weight, eider down is the most effective heat retainer of all the clothing materials at present known. Until lately it has been but indifferently appreciated and little used in this country, though well understood and largely used long ago, in North Germany, and North Europe generally.

The eider duck is an Arctic sea bird that sometimes wanders as far south as the Hebrides, the Orkneys, and Newfoundland. It is about the size of the smaller varieties of our common domestic duck, with a more pointed goose-like bill, and flatter head. Its colour is yellowish brown, with black stripes. Like other aquatic birds, it is clad with an underdown composed of delicate fibres as fine as hairs, but much stiffer, and more elastic. This beautiful fibrous structure holds imprisoned an unbroken envelope of air, which not only keeps the bird perfectly dry, but sensibly increases its buoyancy.

Perhaps I should add that this attribution of buoyancy to the aërial envelope of ducks is a heresy of my own, like my denial of the oiling of duck's feathers to keep them dry; but if "G. A." or any other reader is sceptical, let him test the specific gravity of a plucked duck, or a dead duck in wetted feathers, by placing it on the water. The plucked duck will sink; the wetted specimen *may* float, but its height above the surface of the water will contrast curiously with that of the living swimmer. If the reader has still any residual affection for the traditional nonsense concerning feather-oiling, let him pick up a living duck, thrust his fingers into its breast down—that which rests on the water without wetting—and then observe whether any greasiness is left on the fingers. Afterwards do the like with the wool on a sheep. In the latter he will find the greasy condition that should pertain to the duck's clothing if the feathers and down were oiled.

I have at the present moment a loving and faithful duck that feeds from my hand, and follows me like a dog. This docility has enabled me to detect the probable origin of the feather-oiling fables. At times the animal bites the region near the tail very savagely, and proceeds with further energetic nibbling over other parts of the back. I have examined the bill while this is proceeding, but find no trace of oily deposit on it. It is usually wetted very palpably with water. Further observation supplies a very simple and unromantic solution of the proceeding. Ducks, like all other poultry, are infested with fleas; the duck's fleas prefer the non-immersed parts of the body, and hence congregate on the back. Instead of a squeezing out of oil a driving out of fleas follows the pinching which Paley describes.

An Arctic marine bird which, like the eider duck, feeds on marine mollusca, and is consequently exposed to rough surf washing, requires an abundant supply of surrounding air cushion, especially on the breast. This also serves as warm clothing during the bitter winter, but must be rather burdensome in the hot Arctic summer time. At this period it disposes of such oppresive clothing by tearing it off and using it for nest making. So valuable is this down that in Iceland the eider duck is rigidly protected, anybody who kills one is liable to a heavy penalty (30 dols. in nesting time). They are similarly preserved in Norway. When at Vardö (lat. 70° 22′) I had to obtain special permission to visit a little verdant island N E of the town where the eider ducks were sitting. An official duck protector was sent with me. We found the ducks curiously tame. One was lifted off her nest, the mat of down and eggs carried some distance, deliberately examined and replaced; the duck returned and resumed her sitting at once.

The bed of down was about fifteen inches square and two inches thick; about 450 cubic inches of dark grey fluff, with very little admixture of foreign matter. The eggs about the size of our domestic duck eggs, green, or greenish-blue, with black spots. The nests are robbed of their down two or three times, and the duck renews it, finally with some assistance from the drake. If the robbing is repeated oftener, the nest is deserted, and the ducks find another home. Hence the necessity for stringent regulations in localities where they supply a notable revenue, as at Vardö, where a little community numbering about 1,200 are dependent on two harvests, one of codfish, the other eider-down, with a small supplementary crop of a luscious three-lobed, scarlet berry, the *moltebeer*, which covered the duck's island with a rich carpet of its trailing vine, and spotted it all over, when I was there, with millions of white flowers. The scene presented by such verdant and floral luxuriance on a bright sunny midnight in July violently corrects the commonly prevailing delusions concerning the climate of "the Arctic regions."

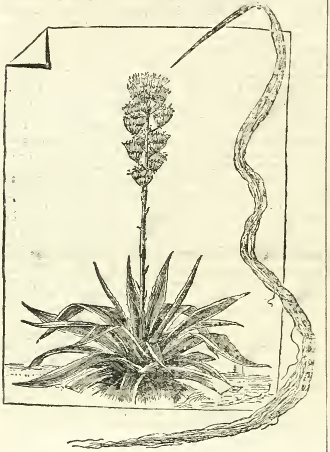
THE NEEDLE AND THREAD PLANT.

THE *Agave Americana*, or maguey of the Mexicans, is known as the century plant among our collections, the latter name being given to it from the erroneous idea that it bloomed once in a hundred years, and "with such rapidity as to resemble the explosion of a cannon." The period at which the plant really flowers is owing to the climate and the cultivation to which it is subjected. In warm countries twenty-five years is sufficient to bring the flower to perfection. Mr. Hawkins, in his "Transactions of the Horticultural Society," gives an account of the most remarkable instance on record of the flowering of the American aloe. Without manure or protection this plant bloomed in eighteen years, having attained a height of twenty-seven feet, and having on it forty flowering bunches, each with four hundred blossoms,

making sixteen thousand flowers in all; the scape, with its panicle of rich yellow blossoms, being in appearance like a candelabrum.

The vast plains in the interior of Mexico is the home of the maguey, and the plant with its thorny leaves imparts a peculiar character to the Mexican landscape.

The strange form of the plant and the rarity of its blossoms are not the only circumstances which recommend it to our attention. From the leaves, roots, and sap are obtained a variety of products. "The natives," says Obers in his "Travels in Mexico," "make as many uses of this plant as the South Sea Islanders of the cocoa palm—namely, one hundred." The juice of the sap, which is obtained by making incisions in the trunk, being highly caustic, is used by physicians in cleaning wounds.



Its more extended use is that of producing a bitter-sweetish juice known as aquamiel (honey water), which furnishes to the natives a drink called pulque, and when taken in moderation is innocuous and wholesome. The foliage of the maguey yields an extract which lathers water like soap.

The agave holds the place of Asiatic hemp and Egyptian papyrus. Ancient hieroglyphics were inscribed on the leaves, macerated in water, and glued together as the bark of paper mulberry. Much attention has been recently paid to the manufacture of paper from the leaves. "The fabrication of this material is destined to be a great industry," says the "Catalogue of Mexican Products," owing to the quality and cheapness of the material.

The fibres of the leaves with the thorns at the end are applied to manifold uses. The edges of the leaves are indented; at each indenture is a spine. These spines are frequently so strong as to serve the Indians for nails. A needle and thread is also furnished the natives by the simple process of pounding the leaf so as to soften the pulp, then scraping the latter away, allowing the fibres with thorns attached to remain. These are dried by hanging in the sun a few days, and the Indian woman has her needle, which is smooth, and not liable to rust; her thread to sew her coarse dress made from "petal flax" (a textile fabric of this plant), prepared in the crudest manner, yet stronger than cotton which has gone through many processes of manufacture.

A rope is made from the fibre of the maguey, which is used in the mines and for the cordage of ships on the western coast. The poorer classes of Mexico thatch the roofs with the leaves, and these, being concave, serve as gutters to conduct the water away from the eaves. The Greek meaning of agave is "noble," and it is well named, as it is one of the most valuable gifts which nature has bestowed on these tropical regions of America. The wealth of a Mexican often consists in his maguey plantation.—*Scientific American.*

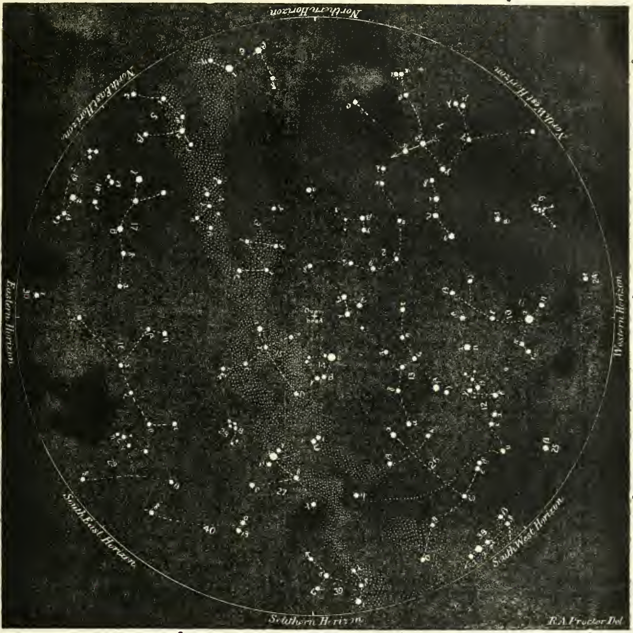
FIRST STAR LESSONS.

By RICHARD A. PROCTOR.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*. the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.

ONE of the most important questions to be brought before the International Telegraph Congress, which within the next few days will assemble at Berlin, is Germany's proposal to introduce a uniform and moderate tariff for telegrams between European States. Under the present system many glaring inconsistencies and inequalities exist.



NIGHT SKY FOR AUGUST (First Map of Pair),

Showing the heavens as they appear at the following hours:—

July 21 at 11 o'clock.	August 1 at 10¼ o'clock.	August 13 at 9½ o'clock.
July 25 at 10¾ o'clock.	August 5 at 10 o'clock.	August 17 at 9¼ o'clock.
July 29 at 10½ o'clock.	August 9 at 9¾ o'clock.	August 20 at 9 o'clock.

THUNDER-STORMS IN AMERICA.

THE Weather Bureau at Washington began special observations in 1884 for the study of thunder-storms, and the New England Meteorological Society has imitated its example this year. These organisations, as well as individual students of such phenomena, will probably find the recent series of storms much the best which this season has afforded for their purposes. These storms, says an American contemporary, were exceptionally numerous and severe in character, and tend to corroborate some general laws which the Washington Bureau provisionally deduced from last year's investigation. One of those rules is that the great majority of thunder-storms occur to the south-eastward of a centre of low barometer. The odd thing about this is that none happen to the north-eastward; for, ordinarily, in storms devoid of electrical phenomena, rain falls in places almost equally numerous on either side of the generally eastward line along which the low centre advances. When the recent series of storms, with lightning, hail or rain, and destructive gales began, on a recent Friday night, in South-eastern Dakota, the greatest barometric depression was in the North-western corner of that Territory. Of the scores of disturbances that ensued, in Southern Minnesota, Wisconsin, and Michigan, Northern Iowa, Illinois, and Indiana, the province of Ontario, New York, New Jersey, Pennsyl-

vania, and Virginia, New England and the Eastern provinces, not one, so far as heard from, occurred north of the eastward course of the low centre; and, with few exceptions, all were east of a line dropped southward from it.

The precedents apparently established last year were closely followed in two other respects: the tract of country visited by the rain, hail, lightning, gales, and tornadoes widened, fan-like, as it extended eastward; but the hail generally kept within two or three hundred miles of the low centre. In Dakota the belt of afflicted territory was scarcely a hundred miles wide. Near the Atlantic the storms occurred at intervals from Port Hope, on the Canada side of Lake Ontario, to Woodstock, Va. The hailstorm in north-eastern Pennsylvania was probably the one furthest from the low centre, which at the time was a little west of Ottawa.

Whether any of these local storms travelled more rapidly than the low centre to which they were related, as the Signal Office reports might have led one to expect, does not clearly appear from the current news despatches. Another "preliminary deduction" of the Weather Bureau which was not altogether verified at this time is that the activity of storms dies down at evening and revives in the morning. There were some lively demonstrations in this State and Canada on the Sunday night. A point about which there will be some difference of opinion, too, is whether the destructive waterspouts in Southern Mexico on the Saturday and Sunday were connected with the system of storms under consideration.

How far a conflict between two great air currents of widely different temperatures is to be considered a cause of thunder-storms is not yet determined by scientists. Such a struggle, however, seems to have been closely associated with this particular group. A wave of almost abnormally warm weather which extended from the Gulf of Mexico to Dakota on Friday last rolled steadily eastward the next three days, closely pressed by a cold wave of such intensity that in many places in the North-West the temperature in a few hours fell 40° or 50°, and, in at least one instance, 60°. Near the Atlantic seaboard the change was less decided, yet clearly marked.

The number of visitors to the International Inventions Exhibition for the week ending Aug. 1, was 147,661; total since the opening, 1,866,080.

The following statistics refer to numbers of locks and keys made during the last seven years by Messrs. Hobbs, Hart, & Co.—viz., 1,734,000 locks, 3,876,000 keys, 8,483,000 screws and stumps for various locks, and 6,700,090 rivetting stumps for inside work. Also 7,300 safes, 2,308 strong-room doors and frames, and 397 ventilating gates. The wages paid during the period amounted to £195,000.

Are Stays Necessary?—Many women assert that they derive great comfort from stays, that they support the body admirably, and that without them the wearer feels inclined to "drop to pieces." All this may be perfectly true. But what significance must we attach to the statement that certain women cannot possibly do without stays? Do they mean for one moment to assert that the human body is so ill-constructed and so badly adapted for its purpose in life that it has to depend for its integrity upon the productions of a corset-maker? Such an assumption is simply outrageous, the true explanation being that by the persistent use of stays the muscles of the back have become so enfeebled (from prolonged disuse) that they are no longer able to support the spine. Those who declare, therefore, that they cannot do without stays, adopt the argument of the opium-eater, who maintains that he cannot do without his opium. The long-continued use of the drug has so impaired his system that he feels a constant craving for it. And those who cannot exist unless braced up by corsets have so enfeebled a part of their system that they cannot do without the support upon which they have so long depended.—*The Book of Health* for August.

Reviews.

SOME BOOKS ON OUR TABLE.

Real Property Statutes: comprising those passed during the years 1874-1884 *inclusive.* By Harry Greenwood, M.A., LL.M., Barrister-at-Law. 2nd edition. (London: Stevens & Sons. 1884.)—This is one of the numerous books evoked by the changes in the laws that regulate Conveyancing practice. The notes seem practical and full. The system of printing sections of an amending Statute in the middle of the Statute amended, of course exhibits the present state of the law at a glance; but it would seem to us to be liable to confuse the student of a Statute who may overlook the fact that he has parts of two before him at the same time, and the trouble of turning to another page for the amendment is not insuperable. It of course adds to the bulk of the book, as the amending Statute is printed in full elsewhere, *e.g.*, the whole of the Settled Land Act of 1884 appears in this way twice over. That our objections are rather of a theoretical than of a practical nature may perhaps be held to be shown by the fact that Mr. Greenwood's work has already run into its second edition, and we may add that his general arrangement of his subject-matter is decidedly good.

Representation. By Sir John Lubbock, Bart., M.P., F.R.S. (London: Swan Sonnenschein & Co. 1885.)—Every one who wishes to learn how thoroughly Englishmen will be misrepresented under the new Redistribution Act should obtain this little book, which forms the second volume of Mr. Sydney Buxton's "Imperial Parliament Series." As the result of a most careful discussion of the various modes of election adopted in those countries which possess representative institutions, our author decides upon the single transferable vote as that calculated to ensure the fairest expression of popular opinion; and we may avow our own idea that no impartial and unprejudiced reader can fail to be convinced by his arguments. The philologist, alike with the politician, will read with interest the account of the real historical origin of the term "Gerrymander," which is given on pp. 10 and 11.

The History of Herod. By John Vickers. (London: Williams & Norgate. 1885.)—That the monarch of an ultra-tropical locality is not so black as he is painted, is a proverb dating from mediæval times; and in days when Henry VIII. is exhibited to us as a gallant and virtuous Englishman, with possibly merely a little too prominent tendency to uxoriousness to mar his otherwise spotless character, and Bacon is shown to have been above any conceivable temptation, pecuniary or otherwise, it is not surprising to find that that much-abused man Herod should find a defender—and a defender of considerable ability to boot. It is almost superfluous to say here that for our knowledge—or presumed knowledge—of the chief events in the life of Herod the Great, we are indebted to Josephus, whose bigoted sacerdotal prejudices, unfairness, credulity, and historical untrustworthiness Mr. Vickers trenchantly exposes. That Herod was guilty of cruelty he does not deny, but he shows conclusively the difficult part he had to play, and draws a telling parallel between the rebellious Jews, over whom the famous son of Antipater ruled, and the (so-called) Irish "Nationalists" of the present day. Some of the atrocities, however, attributed to Herod are shown by our author to have no foundation whatever. Among them is the Massacre of the Innocents, in connection with which he points

out that the Census of Cyrenius (Luke ii.) did not take place until ten years after Herod's death! and that while Herod was denounced to the Sanhedrin as a murderer for extirpating a band of murderers who had ravaged the Syrian border, and was only saved through the intervention of Sextus Cæsar, no contemporary writer even hints at the atrocious slaughter of all the children in Bethlehem, which must infallibly have been blazed abroad throughout the Empire. To all impressed with the justice of the ancient aphorism, *audi alteram partem*, we would commend the perusal of Mr. Vickers's really remarkable volume.

Studies in Microscopical Science. Edited by Arthur C. Cole, F.R.M.S. (London: Baillière, Tindall, & Co.)—In his four numbers for July Mr. Cole gives us illustrations, with very full accompanying descriptions, of Marchantia, the Tail-feather of a young Starling, Miliary Tubercle and Interstitial Pneumonia, and a Transverse Section of a Puppy's Tail. Thus the histologist, the pathologist, and the general observer with the microscope will find each something to interest him.

Cremation. By. J. G. Davey, M.D. Reprinted from the *Bristol Medico-Chirurgical Journal.* 1885.—The reader must, we think, be either wilfully blind or abnormally stupid who, upon the perusal of Dr. Davey's admirable tract, is not converted to a belief in the evergrowing necessity for cremation as a substitute for the present terribly unhealthy, and, in more respects than one, revolting system of packing limited areas of ground with a seething and festering mass of decaying humanity. This little pamphlet can scarcely be too widely circulated.

The Dietetic Reformer and Vegetarian Messenger. (London: F. Pitman.)—This is the organ of the "Vegetarian Society" (an association of a very few mediocrities with a superfluity of nobodies), who are apparently going to regenerate the world, abolish doctors, and usher in the millennium by the simple process of eschewing wholesome animal food, and confining themselves to a diet of apples, potatoes, beans, turnip-tops, and the like! We are glad to see that the members of this important sect no longer have the audacity to quote Sir Henry Thompson as an advocate of vegetarianism, but have taken to answering (?) him instead.

Blackie's Geographical Readers. I. to VII. By W. G. Baker. (London: Blackie & Son.)—In few branches of instruction has a greater advance been made within the last quarter of a century than in the teaching of geography; nor do we need a better illustration of this than that afforded by Mr. Baker's capital series of "Readers" now lying before us. The child is taught, *in limine*, what a map or plan of its own schoolroom or playground means, and is instructed how to extend this knowledge to maps of larger areas, and shown how the various forms of land and water are conventionally represented, the meaning of the points of the compass, and the like. Then the young student is treated to a picturesque description of England, and is led on to a knowledge of the shape of the earth. After this, England and Wales are treated more in detail, as are the rest of the British dominions in both hemispheres, in No. IV. Nos. V. and VI. deal with the remaining divisions of the globe; while VII. is devoted to the ocean and the planetary system. The series is at once excellent and comprehensive.

Fifth Reading-Book for Standard V. Sixth Reading-Book for Standard VI. (London: Cassell & Co.)—Gradually increasing in difficulty, as in interest, this capital series of books could hardly be improved upon for the purpose for which it is designed. The grandfathers, and even the fathers, of the generation now passing through our public elementary schools would have stood in amazement at these well-edited and capitally-illustrated volumes. We are delighted to see extracts from the work on "Earthworms," of the immortal Darwin, given as readings in the "Sixth Reading-Book."

Cœsar de Bello Gallico. Book I. With two translations. By John Hugh Hawley. (London: Relfe Brothers.) Mr. Hawley has produced a very useful book, and one well calculated to enable the pupil to understand what he is construing—a not too frequent occurrence. On the left-hand page is given the text in full, with a free English translation beneath it; while on the right-hand page the Latin text is split up into the words in the sequence in which they occur in translation, their literal English equivalents standing opposite to them. The boy must be very dull or very obstinate who fails to construe correctly by Mr. Hawley's system.

How to Teach Grammar. By T. J. Livesey. (London: Moffat & Paige.)—Mr. Livesey gives a series of outline lessons for teaching grammar by question and answer. Children will unquestionably be more interested in a subject imparted in the way here set forth than by the old dreary method of learning paragraphs by rote.

A New System of Book-keeping by Single Entry. By Rev. Dr. Brewer. (London: Jarrold & Sons.)—All those to whom the ordinary system of book-keeping by double entry presents difficulty may with advantage study the simple and practical method of single entry explained by Dr. Brewer in the volume before us, and exemplified in a series of working books accompanying it.

Lettice: A Tale in Verse. By Mrs. John Sharp. (Tunbridge Wells: A. K. Baldwin. 1885.)—This posthumous little story is not without a certain amount of grace and interest. In its main incidents it approximates to "Enoch Arden," although its ending is not identical with that of the Laureate's tale. The versification is smooth enough, but here and there the scanning of a line is dubious, and occasionally (though we are bound to say rarely) we come across something like a deliberate defiance of Lindley Murray. "As had belonged to Robert," or "Grew more and more Hugh's company affect," seem to us a little to exceed the limit of poetical licence.

Daisy Dimple: Her Loves and her Lovers. By the Author of "Giles's Trip to London." (London: Jarrold & Sons.)—There is a charm about this simple little Norfolk Idyll, for which it is not, at first sight, easy to account. Almost destitute of incident, and wholly and absolutely free from sensational element as it is, the reader will never stop after opening this account of Dolly's courtship until he (or she) has read to the very end of the book. The author would appear to have had "Mrs. Brown at the Play" in his mind in giving his description of the theatrical booth at Tombland Fair, but every other line in the book is redolent of rural Norfolk. It is a charming and innocent sixpennyworth.

We have also on our table from Messrs. Cassell & Co.: *The Library of English Literature, The Book of Health, European Butterflies and Moths* (with a beautiful engraving of the Death's-head Hawk Moth and its Caterpillar). *The Countries of the World, Cassell's Popular Gardening, Cassell's Household Guide,* and *Our Own Country.* We have further, *Gold and Silver and the Depression of Trade,* by Samuel Smith, M.P., *The Medical Press and Circular, The Tricyclist, Wheeling, Society, Bradstreet's, The Sanitary News, The Sidereal Messenger, Ciel et Terre, Le Franklin, Electricité, The Season, Naturen,* and Blackie & Sons' *Educational Catalogue.*

CHATS ON GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

THE SPHERE.

(*Continued from page* 75.)

A. Can we determine the volume of a portion of the sphere cut off by a plane as L M N, Fig. 3?

M. Quite easily. Take first the volume, L A N, and let a plane L O N cut the enclosing cylinder in $l\,n$. Then the volume L A N is equal to the solid sector C L A N, diminished by the cone C L N; and we know by the method of our proof for the whole sphere, that the volume of the solid sector C L A N is equal to $\frac{1}{3}$rd the volume of a rectangular parallelopiped having a base equal to the curved surface of cylinder $t\,l\,n$ T and height equal to the radius of the sphere; while the cone C L N is also of known volume, when the position of the point O is known. But to get suitable expressions for the volumes of spherical segments we may conveniently proceed as follows:—

Let the angle A C L $=\alpha$; then L O the radius of circle L N $= r \sin \alpha$; C O $= r \cos \alpha$; A O $=$ vers α.

$$\text{Hence vol. of sector CLAN} = \frac{r}{3}\cdot 2\pi r^2 \text{ vers } \alpha = \frac{2\pi r^3}{3} \text{ vers } \alpha$$

$$\text{vol. of cone C L N} = \frac{r\cos\alpha}{3}\cdot \pi r^2 \sin^2\alpha = \frac{\pi r^3}{3}\cos\alpha \sin^2\alpha$$

$$\therefore \quad \text{vol. of segment L A N} = \frac{\pi r^3}{3}\left(2 \text{ vers } \alpha - \cos\alpha \sin^2\alpha\right)$$

$$= \frac{\pi r^3}{3}\left(2 - 3\cos\alpha + \cos^3\alpha\right)$$

$$\text{Similarly, vol. of segment L E N} = \frac{\pi r^3}{3}\left(2 + 3\cos\alpha - \cos^3\alpha\right)$$

$$\text{Also, vol. of section B L N D} = \frac{\pi r^3}{3}\left(3\cos\alpha - \cos^3\alpha\right) \qquad (1)$$

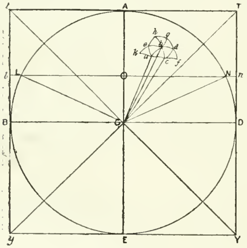


Fig. 3.

This last result is all that need be remembered, and owing to the prevalence of 3's in it, it is very easily held in the memory.

A. What is the volume of a slice of the sphere between two parallel planes, neither of which passes through the centre?

M. We get the same volume whether the planes are parallel or not so that they do not intersect within the sphere. Thus let one be such that the angle corresponding to L C O $=\alpha$, while the other is farther from the centre, and has the corresponding angle $=\beta$. Then, the volume of the space between these two planes, if they do not meet within the sphere, is obviously

$$= \frac{\pi r^3}{3}\left\{ 3\left(\cos\beta - \cos\alpha\right) - \left(\cos^3\beta - \cos^3\alpha\right) \right\}$$

$$= \frac{\pi r^3}{3}\left\{ 3 - \cos^2\beta - \cos\beta\cos\alpha - \cos^2\alpha \right\}\left(\cos\beta - \cos\alpha\right)$$

But we are getting a little outside of geometrical methods.

A. What proportion does a sphere bear to the enclosing cube?

M. The volume of the enclosing cube is $(2r)^3$ or $8r^3$. Therefore

$$\text{vol. of sphere : vol. of enclosing cube} :: \frac{4\pi}{3} : 8 :: \pi : 6$$

$$\text{or roughly,} \qquad :: \frac{22}{7} : 6 :: 11 : 21.$$

A. I think the usual idea is that a sphere occupies a larger proportion than this of the space within an enclosing cube. It is little more than half! So that if you have a box of spherical bodies, say cannon balls, set so that each row falls exactly alongside or above the neighbouring rows, the lines joining the centres forming right angles with each other, the spaces between the spheres amount in all to only 10-21st parts of the whole space!

M. That is so. But the balls can be more closely packed, as when set in triangular or quadrangular pyramids.

A. Which arrangement is the better of those two? I mean for closeness of fitting?

M. They are in that respect precisely the same. I hope, hereafter, to extend our inquiries in that direction.

A. Can we do anything with spheroids and ellipsoids?

M. Our results are very easily extended to them. Thus,—

An oblate spheroid may be regarded as produced by shortening every perpendicular to a certain great circular section of a sphere in a certain proportion, while in the prolate sphere every perpendicular is lengthened in a certain proportion. This circular section is the equatorial section of the resulting spheroid. By taking any plain perpendicular to this section and lengthening or shortening in a given proportion all the ordinates perpendicular to it, our spheroid becomes an ellipsoid. Hence, manifestly, by regarding these perpendicular ordinates as elements of the volume, we get the following results:—

Volume of an oblate spheroid having a for the radius of its principal circular section, and b for its shortest semidiameter

$$= \frac{4}{3}\pi a^2 b. \qquad (1)$$

Volume of a prolate spheroid having b for the radius of its principal circular section, and a for its longest semidiameter

$$= \frac{4}{3}\pi a b^2. \qquad (2)$$

Volume of an ellipsoid having semiaxes a, b, and c

$$= \frac{4\pi}{3} abc. \qquad (3)$$

(*To be continued.*)

The Great Glacier of Alaska.—According to the *San Francisco Courier*, the great glacier of Alaska is moving at the rate of a quarter of a mile per annum. The front presents a wall of ice 500 ft. in thickness; its breadth varies from three to ten miles, and its length is about 150 miles. Almost every quarter of an hour hundreds of tons of ice in large blocks fall into the sea, which they agitate in the most violent manner. The waves are said to be such that they toss about the largest vessels which approach the glacier as if they were small boats. The ice is extremely pure and dazzling to the eye; it has tints of the lightest blue as well as of the deepest indigo. The top is very rough and broken, forming small hills, and even chains of mountains in miniature. This immense mass of ice, said to be more than an average of a thousand feet thick, advances daily towards the sea.

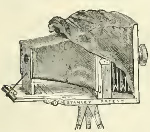
A Medical Electric Lamp.—The electric lamp used for examining General Grant's throat, manufactured by agents of the Edison Light Company, is mounted on a hard rubber holder, about 7 in. long, having a reflector at the lamp end, by which the light can be thrown to any desired angle. The holder is connected by two silk-covered wires to a small storage battery carried in the pocket of the physician. The light is turned on by simply pressing a small button on the rubber holder, and the quantity is governed by another button convenient to the operator. The lamp in inserted in the mouth almost to the palate, with the reflector above the lamp, which throws the light down the throat. The lamp has no unpleasant heat, and gives a light equal to half a sperm candle. The extreme simplicity of the whole appliance makes it very valuable to the physician and dentist.

Colburn's wood and paper brake shoe, a shoe consisting of alternate layers of compressed paper and wood, of about $\frac{1}{4}$ in. each, has, the *Railroad Gazette* says, been recently tested on the New York Elevated Railroad, three cars on the Third Avenue line having been equipped. These cars are stated to have been in daily service for thirteen weeks, making a run of 9,271 miles, against eight weeks and 6,000 miles of the standard metal shoes of the road. This, it is claimed, would equal a run of 200,000 miles on an ordinary road, since the number of stops is about twenty times as many. Quicker stops can be made than with metal shoes, it is said, and naturally with much less wear to the wheel tread. The patentee is L. S. Colburn, of Oberlin, O. There is especial necessity for some other than a metallic shoe on the elevated roads, if it can be had, to avoid the annoyance and danger to eyesight of flying particles of metal.

Our Inventors' Column.

PHOTOGRAPHIC CAMERA.

[Patent No. 4,528. 1885.]—We have here an invention—by Mr. W. F. Stanley, of Railway-approach, London-bridge—in which a separate focussing-cloth is dispensed with. In this camera, by the addition of a light, conical silk bag placed horizontally behind the focussing screen, the ordinary loose focussing-cloth is dispensed with. The same conical bag carries at its apex a magnifier, which answers as a focussing-glass, and the whole apparatus becomes lighter than when the focussing-glass and cloth are separate parts.



At the same time the head of the operator is not stifling under a cloth, or subject to the nuisance of its blowing about or its occasional loss in windy weather. To quite protect the camera from light a second loose silk cover draws over the bellows and open parts. This patented apparatus can be adapted to any camera. An important feature is that the operator is able to look about him at the time of focussing to secure the best view, and avoid any obstruction that may appear from moving objects. The conical bag is made to stand out at the focus of the glass, when required, by pressing it upon two studs.

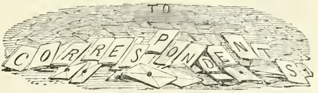
METALLIC VAPOURS.

[Patent No. 7,731. 1884.]—It is well known both to agriculturists and metallurgists that proximity to smelting-works is not conducive to the production of large crops or to the health of cattle pastured on such land; in fact, the records of our Law Courts show us that manufacturers are continually having to fight actions brought by neighbouring landowners for damage sustained by their property caused by the deposition of acid and metallic vapours from their chimneys.

Many plans have been introduced from time to time in order to prevent the emission of metallic vapours into the atmosphere. Some few of these are chemical, but most mechanical in their action. The plan patented by Mr. Ernest H. Cook, B.Sc., of Bristol, is very simple, and at the same time proposes to recover some at least of the valuable metals, as well as sulphur, which are now allowed to vitiate the surrounding air. The raw material which is used in the process is the waste product from the alkali works. This material, large quantities of which accumulate near chemical works of this description, is at present of practically no value—in fact, is a source of annoyance, and any use for it would be a benefit not only to the alkali-maker himself, but also to the dwellers in the vicinity. When steam or steam and air is blown through this waste, a large quantity of the sulphuretted hydrogen or of the alkaline sulphides, which it contains, are removed and carried along with the steam. If this steam thus charged be brought into contact with sulphurous anhydride, a chemical decomposition ensues, resulting in the deposition of sulphur. Any metallic compounds are likewise decomposed, and the sulphides deposited. The application of these facts to practice is exceedingly simple. In almost all smelting-works the gases from the furnaces are made to pass through a series of long flues and chambers prior to their exit from the stack. In these flues the gases are cooled, and a large portion of the substances deposited. Mr. Cook proposes to pass into these flues, chambers, and passages, at various intervals, the steam charged with the sulphuretted hydrogen obtained as before mentioned. Immediate chemical action occurs, resulting in the precipitation of large quantities of sulphur. The metallic substances present combine with the sulphur of the sulphuretted hydrogen, and are deposited as sulphides. The formation of the solid sulphur by the union of the two gases aids the deposition of the metallic compounds by mechanically enclosing them, and the result is that no metallic vapours reach the stack to be given off into the air.

Thus this process, in addition to affording a protection to the smelter from the, in many cases justifiable, complaints of his neighbours, furnishes him with a means of regaining as a marketable article a substance which is now allowed to escape. When it is mentioned that for every ton of lead made from galena there is produced more than six hundredweight of sulphur dioxide, the importance of recovering the sulphur becomes evident.

The plan is of very general application, as sulphur dioxide is an almost constant product in all metallurgical works.



"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THE RUDDY ECLIPSED MOON.

[1847]—May I be permitted to suggest another theory to account for the "ruddy eclipsed moon?" If not a scientific theory it has the merit of being a common-sense one. In the absence of moonlight, when the atmosphere is clear and transparent, and the stars shine out in full effulgence, we become sensible that a large amount of light from that source passes through our atmosphere by the distinctness with which distant objects are seen in considerable detail. The moon, like the earth, is surrounded by the starlit heavens, and should reflect from her surface sufficient light to make her non-sunlit disc more or less visible to us in times of total eclipse, as circumstances are more or less favourable. The pale or ruddy colour must depend on conditions of our atmosphere as to the amount of moisture diffused in the higher regions. If the sun rises in fog it assumes a ruddy colour, which becomes lessened as he rises towards the zenith, even though the fog remains as dense as at his rising. According to this theory, the eclipsed moon should be more ruddy at times when rising or setting in eclipse, and when at or near the meridian in the winter solstice of our atmosphere. Henry J. Madge.

[The "large amount of light" which Mr. Madge appears to suppose reaches us from the stars has no existence, save in his own imagination. Taking *a* Centauri as his standard star of the 1st magnitude, Sir John Herschel determined that a cluster of 27,408 such stars would only give the light of the full moon. There are never more than 1,600 stars visible at one time on the darkest night, and of these, *four*, perhaps, will be of the first magnitude. Further, bearing in mind that it would take $2\frac{1}{2}$ stars of the 2nd magnitude to make one of the 1st; 6 of the 3rd, 16 of the 4th, 40 of the 5th, and 100 of the 6th magnitude to emit the light of a single star of the 1st magnitude, it will easily be seen how wild is the notion that we are indebted to the stars for any sensible addition to the lightness of our nights. Whithersoever we derive it, it is not from them.—Ed.]

THE PAST OF THE MOON.

[1848]—I think there is some value in Mr. Mackie's contention that there might have been men in the moon, but that they had not time to develope as we have done (letter 1812)—Again, they might have been pygmies. Still, when we look back, and see that there must have been human works thousands of years before the Pyramids—such as Uley Bury in Gloucestershire, a quadrangular earthwork which from the moon would be a fine object with a not very high power—and when we consider that the earth is no less habitable, no cooler than in those past æons—nay, much hotter than in some—it seems probable enough that the moon's inhabited days—if there were such—lasted long enough for the lunarians to get as far as *pahs* like Uley Bury.

My chief reason was the absence of river-beds in the moon. I used to spend hours in studying her face with a telescope, and never could persuade myself she ever could have been like the earth in general arrangement. Her hollows are all isolated, like the Caspian—she is like a cinder—whereas on the earth the oceans carry us from one end to another. On Mars, too, this is the case—He has very little water, but it seems to circle all round his continents, like our own "ocean stream."

I think Mr. Proctor says there is evidence of water-work on the

moon. That is very strong against me; but I do not see how there could be water without rivers.

There is nothing to show that planets die, so long as they have their sun. Our latent heat is evidently of no use to us, since our poles are, in spite of it, inaccessible. (We might have immense projections there, for all we know,—were it not that we have seen their shadow on our satellite.)

Mr. Mackie urges that the Great Pyramid has lost 1/22 of its height in forty centuries. That is not much, and it has been by human destruction; which now will probably cease if we keep hold of the country.

I cannot agree with Mr. Mackie (1831) that there is any proof of lunar tides in the past history of the earth; because the heaving of her surface has subjected all parts in turn to the action of the solar tides, which I take it would be considerable—*i.e.*, the difference between a spring and a neap tide.

It is (*pace* Mr. M.) a positive fact that in this country no landscape ever looks blue like a Scotch, Irish, or even English one. How it can be that "the warmer the climate the more water will its atmosphere hold in suspension," is beyond me. I live south of England because the perpetual damp of my native land prevents me from living in the open air half the day, as I do here even in winter. The people here just now are crying out against "the intense heat." In point of fact, the *heat* is not great at all; at this moment 77° in the shade; but the *dryness* is something rare, even for France, and especially for the seaside; and they confound it with heat. Rolls delivered in the morning are, even in a cellar, like ship-biscuit in the afternoon. This I never knew here before: it is therefore the dryest season for the last ten years. Where in G. B. would bread harden like this? If there is *more* water here, it must be a very long way aloft; so long as to become "*un quantité négligeable*," especially as regards the blueness of the landscape, which may be supposed to be nearer.

Mr. M. says "from a chemical standpoint, oxygen and nitrogen *cannot* be 'frozen'"—yet in this very no. of *K.*, at p. 80, it is stated that "Nitrogen is solidified at −214°." Perhaps Mr. M. in his next letter will demonstrate that "solidified" and "frozen" are two different things; as also that the parched Soudan has really more water (somewhere) than "the storm-swept Orcades."

"It was the fine blue of eastern skies which gave birth to the 'waters above the earth' theory." If Mr. M. states this of his own knowledge, he must have been present, one would say as "our correspondent," on that great occasion "when the morning stars sang together, and all the sons of God shouted for joy." I had supposed that rain was a mere obvious origin of the belief.

Hallyards.

METEORS.

[1849]—While observing the moon at 9h. 45m. on the 22nd ult. with a 4-inch, by Cooke, power 65, I saw a dark object glide across the face of the moon from west to east, which appeared two inches long and one and a half inch wide. It occupied only five seconds in transit. It was evidently not a bird, there being no movement of wings. It occurred to me that it was possibly a meteor passing beyond the limits of the earth's atmosphere. Perhaps "F.R.A.S." may be able to state whether meteors have been seen in this way. On the following evening, at 10h. 35m., I saw a great fire-ball, or meteor, gliding across the sky in the same direction and near the same spot. The apparition did not occupy more than three seconds, and it was rather of a startling nature. The ball itself was apparently about half the size of the moon; the front part of it was of a white colour, and the tail itself was composed of red flame about two degrees long. It disappeared instantly, without any explosion. As regards its distance from the earth, it really appeared to be about three hundred yards from me.

J. Webb.

[The first apparition spoken of by Mr. Webb was almost certainly that of a distant bird, or of an insect (a cockchafer, or the like) much nearer. Many slowly-flying birds flap their wings less frequently than once in five seconds. There is no recorded instance of a meteorite having been seen dark on the brighter background of the moon or sky.—Ed.]

EVOLUTION AND NATURAL SELECTION.

[1850]—"Commentator" reminds us, in his original and effective manner, that "it took five hundred years for Christianity to establish itself." Will it be unfair or ungenerous if I add that Darwinism has only taken five-and-twenty, and has yet to win its credentials from Time, as well as from enthusiastic professors, before it can, without question, be accepted as an explanation of everything? It has, as victor, too, recently come away from conflict with "special creation;" it has to dwell too emphatically upon certain truths to be perfectly reliable. There is more than a suspicion of exaggeration clinging to many of its doctrines; it suggests the swing of a pendulum, or the recoil of a spring, rather than the balance of a true science; and a day may yet come when, over some of it most popular axioms, we shall have to say:—

"Our little systems have their day;
They have their day, and cease to be," &c.

"Commentator," so far as I can gather, does not object to "natural selection" being accepted as a *part* of nature's scheme. He objects to it as a *universal* law. And that is exactly my position. He and I are in perfect sympathy upon that subject, I fancy. Unfortunately, too, many evolutionists are very arbitrary upon this point. They will have nothing but "natural selection"; and they will evolve you a race or an individual from their cut-and-dried formulas, as though the thing possessed no more difficulty than developing a photographic picture.

This is a great mistake: "natural selection" does account for a great deal, and is worthy of profound study; but *alone* it does not account for the existence of any one single thing. It is a guiding influence, not a creative one. It is present wherever there is a conflict, and gives victory to the strongest; but it does not impart life and energy to such. The motive power, the creative impulse, lies far deeper—aye, infinitely deeper—and of that we as yet know nothing. "Natural selection," however, is not everywhere a directing and guiding influence. There are peaceable realms in life (such need not be the lotus-eater's paradise) where nature, far away from the border-lines of strife, can freely make the world the gift of a Plato's mind or a beautiful orchid, a race of musical Bachs or an Ancon sheep.

But, after all, for what is the evolutionist—I mean the recent conventional evolutionist—contending? Is he anxious to prove that nature abhors a leap—that species and races slide imperceptibly into one another? If so, he totally fails. Variation supposes leaps, and Darwin himself recognised the fact. If a bird is born with one feather more than his fellows, it comes into possession of that feather suddenly, and not by imperceptible gradations. So, too, with the six-fingered men, Niata cattle, &c. It thus becomes a question as to the size of the leaps we imagine nature is capable of taking; and it seems to me, in our total ignorance of the prime moving energy underlying phenomena, that it is presumption on the part of Darwinians to assume that those leaps, those steps, can only be of the minutest character. Are we to be told that nature abhors a leap beyond a certain point, as certain philosophers said once concerning a vacuum? If, as Mivart says, there is "an internal force or tendency" in life to produce all we see independently of natural selection, then there is no reason why such a "tendency" should be tied down to infinitesimal gradations. It is a necessity which has grown out of a theory, and that theory is Darwinism.

"Commentator" has often imparted vitality to his views with illustrations drawn from music. It is an art to which, I think, we may more frequently appeal in our speculations with considerable profit. The world is born again in music. It comes to us in new raiment; unfolds its meaning, as it were, in a new set of terms, say as 1, 2, 3, 4, instead of a, b, c, d. The same relations are there, and the same laws. You are strangely conscious of familiar simple ideas, such as softness, hardness, sweetness, richness; and once more you recognise the centripetal and centrifugal forces at work in tonic and dominant.

But can it teach us anything concerning Darwinism? Certainly. In the Tartini tones there is correlation. In the old Greek genera and modern chromatic scale you can observe the small steps upon which the evolutionist now lays such emphasis; nay, in the portamento, if you like, you can point to one thing gliding into another. But there are *breaks* also. There is no bridge to carry you from the common chord to the chord of the 7th; nor in the arithmetical ratios of our diatonic scale is there any link between 6 and 8. The same thing holds good with musical instruments. You may trace the violin back to the crwth by any number of intermediate variations; but from the harpsichord to the piano you must make a leap. I can only throw these things out as suggestions now; but I daresay most of your musical readers will understand their application.

Gamma.

PHILOSOPHY OF CLOTHING.

[1851]—Garters are not necessary where drawers or pantaloons are worn, or with knickerbockers, provided they are ribbed the whole way up. I always wear stockings during the winter, but never garters.

Suffering from the heat, I had a special thin coat made for me, lined with the ordinary silk lining stuff. Although very thin, it is warm, being black and tight-fitting. So I had another made, a thicker coat, and lined with a special flannel. It is also black; though heavier, it is far cooler. I always wear flannel when walking or tricycling for coolness, and find that a winter-coat so lined

is cooler than a summer one lined with the ordinary stuff. I first had my coats and waistcoats flannel-lined over a year ago.

JOHN ALEX. OLLARD.

OIL-GLANDS IN DUCK.

[1852]—In reply to Mr. Williams, on page 539, he says that Paley describes it as a "specific provision for the winged creation," but does not say for what purpose. There are many naturalist writers of note, both English and American, of a much later date than 1802, who positively state and describe this organ to be an oil-gland—names and quotations from which I could send you (after a little search) if the editor does not think the matter too trivial to occupy space in his paper, when such acknowledged authorities have long ago admitted the fact.

Will Mr. Williams kindly say what he supposes to be the use of the two little heart-shaped glands lying across and just before the root of the tail, traversed by little ducts uniting in a tube, which terminates above the skin in one and sometimes two little nipples, and which is largest and most fully developed in aquatic birds; and if the part be not an oil-gland, why the bird, when dressing its feathers, takes this nipple in its beak, then passes head and throat over the part, and then over all parts of the body-feathers (without the aid of a paint-brush)—for that such is the general habit of birds it would be only idle to dispute? G. A.

HOW TO GET STRONG.

[1853]—Hallyards doubtless knows a great deal, but not everything, or he would not speak of a joiner's *table*. Further, what does he mean by "involuntary motion;" it makes one think of "the jumps." If he means motions such as walking, which when once commenced are kept up *almost* automatically, what reason is there that other bodily motions, such as those described by Mr. Proctor, should not soon become so? They do so as a matter of fact. At one time, when reading and writing a number of hours per day, I worked for exercise with weights suspended by ropes passing over pulleys, a machine commoner in the States than in England I think. I always worked with a metronome, and kept a record so that the pace, weight used, and length of each exercise were noted. The motions became as mechanical as any hand exercise can do, requiring attention merely to do them in "good form," and perhaps, after an increase of difficulty, to keep one going to the end. I can testify to the increase of strength and weight that I gained, and I avoided the risk of strain from rivalry which seems to have been Hallyards' incentive; my rivals were time, pace, and weight, and I did not increase them till I had overcome them. I do not think there is anything "lugubrious" in exercise that sends one's pulse up to 120 and over, nor anything "ridiculous" in exercise that puts on muscle and weight which *stand*, and do not disappear as a gymnast's muscle is apt to do, but my nationality, perhaps, prevents my seeing the joke as Hallyards does. His statement that "a walk without a friend or an object is a saddening affair" perhaps tells a tale. One of the best talkers I know loves walking and talking, and, best of all, walking by, and talking to, himself (in silence). He always, in fact, carries his best friend and companion with him. So much for "the friend." As for "the object," surely to a walker, walking, like "the good" of Plato, is an "end in itself." Is life worth living? This depends on the liver, and perhaps a walk being worth walking depends a good deal on the walker.

SCOTUS.

THE ORIGIN OF ETHICS.

[1854]—Replying to "Meter," letter 1828, I do not deny the existence or necessity of "beliefs." Where our knowledge ceases, "beliefs" come in. I care nothing whether the tenets I hold can be reconciled with "seeming respectability," provided they are true; but, at the same time, I object strongly to the quiet assumption of certain beliefs to be the source and fountain of all that has been proved to be true by science and experience. I stated, what I believe to be a demonstrable fact—a truth proved by experience, independent of "theological beliefs"—that the ideas of right and wrong arise from the necessities of man; his state of civilisation, education, &c., and that the tests of right and wrong are within our "knowledge," therefore above, and superior to, "beliefs."

Theft, murder, &c., do happen, are perpetrated every day, unfortunately, and I regret "Meter" should produce them in proof of a supreme being, sanctioning, permitting, or unable to prevent them. To me they seem born of dire necessity, fate, or force of circumstances, beyond the control of man in his present state, but entailing to him inevitable consequences, viz., punishment and misery.

In fact, I hold it to be more useful and effectual to teach and to show that, as from tares sown, only tares will spring; so from ill-deeds done, nothing but evil consequences will flow; crime will be followed by punishment of necessity. I would alter Pope's saying: "Whatever is, is good." There is good, evil, and indifferent; let us strive to increase the good, dimish the evil and indifferent.

F. W. H.

[To be operative, this doctrine must be carried out in all its integrity. That is to say, if, for example, a garotter throttles and robs a man from "dire necessity, fate, or force of circumstances," dire necessity, fate, or force of circumstances, should also entail a long term of imprisonment and a severe lashing with the cat-and-nine-tails on that garotter.—ED.]

THE INCORRIGIBLE CORRECTOR.

[1855]—In letter (1833) "man" is inexcusably and distinctively printed twice—in the first column it was "a highly respectable MOON"—in the second "I doubt whether any NUN ever was put to death."

In Mr. Proctor's comments on my remarks on bad English, the irrepressible has again made a hash. The first words of the third paragraph were clearly "Than *who*"—not "than *whom*"—which states the contrary of what we both mean.

I protest against the expression "I should have liked to have seen him" as being absolutely incorrect in the use in which it has obtained, and as laying down an entirely false rule, *i.e.* that a past tense must be followed by a past tense. Mr. P. objects that "I should have liked to see him," really means "I should have liked—*at some past time not indicated*—to see him." Hypercriticism could no further go! Would any sane man imagine that the speaker spoke of anything but the circumstance reported? If this form be incorrect or ambiguous, how could it be expressed in Latin or French, where the equivalents I gave are the only ones possible?

In the third *par*, surely the comments are otiose; for I myself pointed out that "than whom" would of course be correct there was anything to govern the accusative. Just as "I should have liked to have seen him" is no longer *odious nonsense* when we mean what it expresses. As to par. 4—I did not stigmatise the putting of a pronoun first in the same strong language: it really might be justified from the Greek and Latin usage I cited. But it is done a good deal too often, and is parent of much obscurity and still more inelegance. As Mr. P. says "the reader has to wait"—What can be more objectionable than the delivery of a very long sentence whose whole meaning depends upon a verb which is not mentioned till the end? I can read such books as Livy with more comfort than many English writings; but I confess that I am often obliged to glance several lines down, to find the verb which is the coëfficient of the whole, before I form any idea of what the sentence is about. How the people understood speeches so arranged I cannot imagine. Possibly the orator *spoke* the verb first: it may have been a fashion to change the order for the revised copy. I think Cicero in his letters puts the verb first. Was this out of politeness to his correspondent—to make it easier reading? *i.e.*, did he write *letters* as he *spoke?*

A correspondent suggested a campaign against "commence" for "begin," and "penetrate" for "pierce." But the first is not *corrupt* English: it is chiefly an Irish notion, like "convenient" for "near," and "elegant" for "nice." As to "penetrate," it is not synonymous with "pierce." "I did not succeed in piercing into the sanctum" would sound rather *pigeony*.

In my letter about King's College School, "neck-and-neck" was printed "week-and-week." Now the curious thing here is that "neck-and-neck" is a very common phrase, and "week-and-week" is quite unknown.

A year ago we might have said of our conductor,

"He is gone on the mountain—
He is lost to our *knowledge*—
Like a summer dried fountain—
And left us at college!"

Now that "his foot is once more on his native heath, and his name Macgregor," let us hope that in spite of his long submersion his insulation (*i.e.* Britonism) will be found perfect, and himself as good a conductor as ever. HALLYARDS.

A NEW WAY OF PLAYING THE GAME OF DRAUGHTS.

[1856]—"The game of draughts is now played out." So the writer in the "Encyclopædia Britannica" declares. This seems a pity, as from its simplicity this game has always struck me as possessing high interest. But if such is the case, I trust I may be allowed to bring before the notice of draught-players a modification of the game I invented some six years ago, and which renders the

game even simpler than before, while, as far as I am a judge, it is made even more exciting. We might call this way of playing the game, "Republican Draughts," because I do away with Kings—there are only men.

The following might be called the "claim" of the method, if this were a patent:—

"Whenever a man reaches the last file of squares, he remains quiescent. For his next move, or for any subsequent move, the owner of the man may remove any one of his adversary's men from the board, and place the man that has reached the last file on the square thus vacated."

This is a much more terrible privilege than mere coronation. The game becomes a very intense affair in consequence. It will be observed that here the men are always moving forwards, except when "removing" one of the adversary's men this way. Hence the same position can never occur twice in one game, and thus no game can be drawn. Hence white has a slight advantage.

I now give an example. Suppose White's men are at 2, 23, 25, 28, 29, 30, 32, and Black's at 3, 4, 8, 11, 12, 13, 14 (Black's men orginally having been on squares from 1 to 12, White's on squares from 21 to 32). Suppose White to play. In the ordinary course of the game the White man at 2 would be a King. But not so here. White removes any one of Black's men from the board that he pleases, and stations his own man from 2 on the vacated square. Thus, in the example, White might remove Black's man at 13 or 14, and his move would be written 2–13 or 2–14. I would not allow White to take off Black's back men—that is, to play 2–3 or 2–4, for that would allow White to exercise the same operation several times till he had cleared off all Black's back men, and this would be too great an advantage. Let the rule be, any man but the back. I need hardly remark that White's man, having thus leapt back, can then resume its march forwards, and is just like any other of White's men. I trust the above explanation will be intelligible, and that all your draught-playing readers will consider the matter. I think if two of them were to play a game over in this manner they would be pleased. I hope some result will follow this article.

There is another matter I would like to suggest, and that is concerning the draught-board. Why should we be bound to the chess-board wiih its paltry thirty-two squares. The Polish draught-board is better; but I wonder that no one has thought of the medium between these—a board with eighty-one squares, the men moving on forty-one of these. In symmetry and elegance it is far beyond either. This will be seen by constructing a diagram of it, and numbering the squares, when it will be found that all the diagonals in one direction are in arithmetical progressions, with five as common difference, and all in the other in progressions of four. This is much better than the common board, where the differences are three, four, or five in either direction. For the ordinary way of playing draughts, this would offer an advantage in that there would be fewer drawn games, because there are no double corners, and, for my new way, it would give more variety of position. After all, any one can make himself a draught-board with some mill-board and white paper. As, however, there can be no drawn games in my way, it would not be of so much consequence to have a board without double corners. However, this is quite a secondary point.

I trust that this way of playing draughts will attract the attention of some leading draught-players; perhaps some of their friends may see this paper, and draw their attention to this article.

Œdipus Rex.

"MUSCÆ VOLITANTES."

[1857]—Referring to letter No. 1815, I find in Dr. Smee's book, "Vision in Health and Disease," mention made of "false spots (and chains), which move as the eye moves, and which remain stationary when the eye is fixed steadfastly on an object." It is there suggested that the spots, &c., always exist on the same place of the retina, but this is a mistake. In my own case, although the general form of the chain is preserved, it occasionally shifts its position in the field of view.

My object in writing is to point out to Mr. Thomas that the size of this image floating in the humour of the eye varies in the same way as ocular spectra. If my eye is focussed for parallel rays the appearance is at its largest, while the more divergent the rays become the smaller and sharper is the image.

Does Mr. Thomas's explanation in regard to ocular spectra here apply? Interested.

[The effect spoken of by our correspondent is that too-familiar one to the tired observer with the telescope known as "Muscæ volitantes." They do, of course, shift in the field of vision. They are the shadows of motes in the vitreous humour of the eye thrown on the retina. Obviously, as their angular diameter remains constant they must seem monstrously larger when compared with a very distant object, than they do when contrasted with anything only a foot or two from the eye.—Ed.]

TO MAKE IN HIMSELF OF TWAIN.

[1858]—As many of your readers will, I feel sure, consider it impossible that Mr. Clemens or Mark Twain could have fallen into the mistake about "the full moon all the voyage," mentioned in Gossip in Knowledge of July 17, I send you a copy of some notes I took, intended for the facetiæ columns in the paper we tried to start on board a vessel in which I returned from Australia last year.

Astronomy. A gentleman who has gone into the calculations (thoroughly, he says,) assures me we ought to have a full moon nearly all the way home, if we maintain the rate we are going at.

There was a lunar rainbow visible on the 12th inst. I did not see it myself, but two or three of the passengers have kindly given me the result of their observations. According to one, the bow was complete; according to another, but a very small portion was visible. What struck one observer was the peculiar whiteness of the bow, while another distinctly saw seven colours. There was some doubt as to the position of the moon at the time; some say it had set, others that it was behind a thick bank of clouds, others again that it was shining brightly.

I remember once being flatly contradicted by a so-called well-educated man because I stated that an eclipse of the moon was visible wherever the moon was above the horizon at the time of the eclipse, allowing for clouds of course. J. W. Alexander.

OBSCURE MEMORY.

[1859]—I wrote stupidly about "Arthur's bosom"; corrected in *K.* I at once *remembered* the passage in Henry V., not read since forty years. Why did I not remember it before?

Reading (in O. Feuillet's *Histoire de Sibylle*) of a child who cried for a star, and at last only slept when given a bright object to hold in her hand, (mendaciously warranted a star new-caught) I was seized with a desire to read a packet of letters a century old I believed I had not read. There seemed no conceivable reason for the thought of them coming into my mind. But it was so strong that I hunted them up. What was my surprise to find one sealed with arms whereof the crest was a demi-woman holding up a star in one hand! I know not to whom the coat belonged; to some Austrian brother-officer of a connexion of mine, writing for him (wounded). But I found I *had* read the letters, a year before. Hence it was obscure memory which drove me to them.

Hallyards.

"COCK-SURE."

[1860]—The word "cock-sure" appears to be a favourite with Knowledge at present. Its occurrence in Shakespeare has been pointed out by Mr. Proctor.

Another example of its use by an English classical author may be worth noting.

In Act iv. of Dryden's "Sir Martin Mar-All" (founded upon Molière's "L'Étourdi") the following passage is to be found:—"Nothing vexes me, but that I had made my game cock-sure, and then to be backgammoned." C. F. Clarke.

LETTERS RECEIVED AND SHORT ANSWERS.

T. C. Clarke. No, not for celestial purposes. The opinion of which you speak was merely of the instrument as adapted for terrestrial use. Write to W. Watson & Sons, 313, High Holborn, London, W.C., or to J. Lancaster & Son, opticians, Birmingham, saying exactly what you want. Please note, too, the paragraph in capital letters which concludes those heading the correspondence columns.—N. J. O. H. Walker gives "incidental need" as a meaning of "occasion," and Bailey before him, "cause, reason, necessity, or want,"—and so with other Standard Lexicographers. Hence the phrase "I had occasion to go" is no mere vulgar provincialism, but pure grammatical English.—Knowledge. The nearest approach to a classical symbolic representation of knowledge was Minerva, who was regarded as the goddess of wisdom and learning.—F. W. H. You still sail a little too near the wind. The revolting cant of such productions as that of "Chas. Peace turned Believer," is positively enough to encourage systematic violation of the whole of the Ten Commandments, though.—P. C. B. Will be handed to "Five of Clubs" on his return.—G. G. G. The lines you quote are entirely new to me. Did you find them as a heading to a

chapter in a book? Because pseudo-quotations, the productions of the authors themselves, are not wholly unknown in such a position.—John T. Rae. Your object is a most praiseworthy one; but were I to open these columns to one single appeal for aid, I could not refuse to admit the hundreds which would inevitably reach me in consequence.—Hallyards. Forwarded as you request. You are quite right. I am as jealous of *my* incognito as you are of yours. I would not be intentionally unfair; and most assuredly not to you. Disease or deformity may justify a score of operations which would be—to put it as mildly as possible—useless in the normal condition, and the one you name is very far indeed from being *common*. If my memory serves me, the notice to which you refer was a verbatim reprint, and not an original contribution. That "other correspondent spoke of the acquisition" to which you refer in words which I altered into that form. As for the M.D., I gravely question if any one would notice his ingenious periphrasis. Were I equally clever in the use of it, I could give you my ideas of your contention as to the indication of Divine prescience afforded by—well, by what you refer to. I have no more "animosity" to the curious congeries of works to which you refer than I have to "Gulliver's Travels" or "Phillip Quarll."—A. O. D. Thanks. They break comparatively new ground, and shall both appear.—H. A. B. First part of King Henry IV., act ii., scene 1. I scarcely know what you mean by "the nutritive properties" of water. Boiling it prior to filtering it, renders the destruction of organic germs more certain. It makes the water less palatable, but that is all. Boiled and filtered water subsequently impregnated with carbonic dioxide would be the most wholesome of all as a beverage. Bétal-jews is as near to the pronunciation of the adaptation of the Arabic name of *a* Orionis as can be expressed in print.—Commentator. *Very* eloquent, and full of fine thoughts, but too theological, and certain to provoke an inadmissible discussion on that ground.

Our Chess Column.

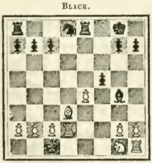
By Mephisto.

ILLUSTRATIVE GAME No. 3.

Centre Gambit played at Hamburg in the Tournament of the German Chess Association, between J. Minkwitz (White) and J. Gunsberg (Black):—

	White.	Black.
1.	P to K4	P to K4
2.	P to Q4	P × P
3.	Q × P	Kt to QB3
4.	Q to K3	Kt to B3
5.	Kt to QB3 (*a*)	B to Kt5
6.	B to Q2 (*b*)	Castles
7.	Castles	R to K sq. (*c*)
8.	P to B3 (*d*)	P to Q4
9.	Q to Kt5	P × P
10.	Kt × P	Kt × Kt
11.	Q × Q	Kt × Q (*e*)
12.	P × Kt	B × B (ch)
13.	R × B	B to Kt5 (*f*)
14.	B to Q3	P to B4 (*g*)

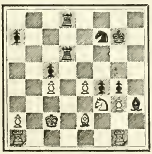
Black.



White.

	White.	Black.
15.	Kt to B3 (*h*)	P to B5 (*i*)
16.	Kt to Q4	Kt to B2
17.	R to B2 (*j*)	P to Kt4
18.	P to KR3 (*k*)	B to Q2
19.	P to KR4	P to KR3
20.	P × P	P × P
21.	B to B4 (*l*)	B to Kt5 (*m*)
22.	Kt to B3 (*n*)	B to K3 (*o*)
23.	B to Q3	K to Kt2
24.	R (B2) to B sq.	P to B4 (*p*)
25.	P to QKt3	QR to B sq.
26.	P to B4	P to Kt4 (*q*)
27.	KR to Kt sq. (*r*)	P × P
28.	P × P	KR to Q sq.
29.	K to B2	R to B3 (*s*)
30.	P to Kt3	B to R6 (*t*)
31.	R to QR sq. (*u*)	R (B3) to K3
32.	B to K2	P to Kt5!

Black.



White.

	White.	Black.
33.	P × P	K to B sq.
34.	P to K5	P × Kt
35.	P × R	P × B
36.	KR to K sq.	B to B8
37.	QR to Kt sq.	Kt × P
38.	K to Q3	Kt to B4 (ch)
39.	K to K4	Kt to Q5

And Black won.

Notes.

(*a*) We have often explained that the only point in White's favour in this opening is that Black has no convenient square for his KB. But by playing 5. Kt to QB3, White offers a good place for the B on Kt5. Either 5. B to K2, or perhaps better still, 5. B to K2 would make Black's development more difficult; for if Black replied with B to Kt5, then 6. P to QB3 would gain time for White to play 6. Q to Kt3.

(*b*) This move deprives White of the initiative in the attack. Unless White plays Q to Kt3 he can never hope to maintain an advantage. If, instead of this move, 6. Q to Kt3, then we think Black could play B × Kt, followed by R to Kt sq.

(*c*) This is a very important move. White is compelled to protect his P, which gives Black an opportunity of playing P to Q4, always a powerful move, when, as also occurs in the Scotch Gambit, the Q is on K3.

(*d*) There is nothing else. If 8. B to Q3, White's position is worse still, for then P to Q4 would be doubly strong, on account of P to Q5.

(*e*) Played with the intention of still keeping the Rook on the isolated P. But on the whole it might have been simpler to take with the R.

(*f*) This move is played to protect the Black Kt with the QR, and to threaten the KP. Thus Black has entirely deprived White of his advantage of the opening, and created a weakness in isolating his P.

(*g*) At first sight the move looked good, as White cannot play P × P; but in reality it created a weakness in Black's game, depriving him of his slight advantage in position.

(*h*) A fine move. If now P × P, then 16. R to Ksq, B to B4. 17. QR to K2 winning the P back, and having got rid of the isolated P, B × Kt would be no better, for the black Kt is inconveniently placed on Qsq, and R to Q7 would also become embarrassing to Black's game at a future period.

(*i*) A disagreeable alternative to taking the P; for although this still leaves White's isolated P, yet it may become very difficult to defend the P on B5.

(*j*) As will be seen, the KR on Rsq comes into good play presently.

(*k*) It is of importance that this B should be driven back first; the move betrays very good judgment on White's part.

(*l*) Now, the importance of first driving back the Black B can be seen, as White threatens R to R5. If Black plays R × P, then White would win by 22. B × Kt (ch), K × B. 23. R to R7 (ch), K to Ksq. 24. R to R8 (ch), &c. But this move looked stronger than it really was, and is on a par with Black's fourteenth move.

(*m*) Prevents R to R5; also removes the B from his dangerous position.

(*n*) 22. B × Kt (ch), K × B. 23. R to R7 (ch), K to B3. 24. R × P, R × P, and White would have no advantage.

(*o*) Of course, R × P was inadmissible. This move forms the turning-point in the game. If 23. B × B, R × B Black's position is better than White's.

(*p*) An important counter-demonstration; it prevents Kt to Q4, besides threatening P to B5.

(*q*) With the intention of advancing P to B5, if White took the P, thereby breaking up the Queen's wing.

(*r*) Still hoping to maintain the original attack on the K side, for which, however, Black gave White no more chance.

(*s*) This threatens R to Q3 as well as R to R3; it is therefore a far better attempt at doubling the Rooks than R to Q2 or Q3 or R to B2. A matter of judgment, which greatly aids in bringing about winning positions.

(*t*) Black might have played R to R3, to which White would have replied with 31 P × P also R (B3) to Q3, 31 B to K2, &c. But the move in the text is the strongest; as it forces the R away from the B file, he cannot go to B2, as Black would reply R to R3, threatening to win a piece by R × P (ch). Nor can the White R play to Q sq. on account of B to Kt5.

(*u*) 32 B to B sq. was necessary to prevent immediate loss.

Our Whist Column.

By "Five of Clubs."

It has been suggested to me that occasionally I should give some simple examples of Whist play illustrating the mistakes commonly made in home Whist. The following example may amuse beginners. It will be observed that the hands were so distributed as greatly to favour *A-B*, but by the system of play in which all the winning cards are played out at once, *A-B* lost the

odd trick in the most unaffected manner. With correct play they would have made five by tricks as shown, without any specially strategic feats:—

The Hands.

B { S. K, 7, 6. D. 10, 4, 3. H. Q, 5, 3. C. A, 10, 9, 7. }

Y { S. Q, 9, 3, 2. D. 8, 7, 6. C. K, 8, 6. H. Kn, 9, 2.

B

Y Z

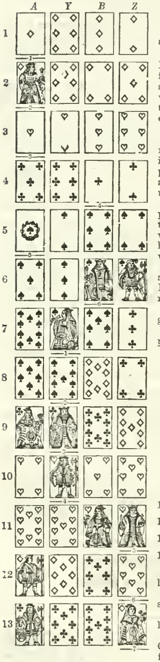
Tr. S. 4.

A leads.

Kn, 4. S. Q, 9, 5, 2. D. 4, 3, 2. C. K, 8, 7, 6. H. } Z

A { S. A, 10, 8, 5. D. A, K, Kn. H. A, 10, 4. C. Q, Kn, 5. }

Score:—*A-B*, 0; *Y-Z*, 4.



NOTES ON THE (ABSENCE OF) PLAY.

Card underlined takes the trick and card next below leads next.

A-B having four Aces, two Kings, two Queens, two Knaves, four Tens, and seven trumps to six held by *Y-Z*, play out all their winning cards before they lead trumps, and thus disarmed lose the odd trick to *Y-Z*'s smaller cards.

1, 2, 3. First disarming.

4. *A* leads a small Club as the most effective way of disarming in Clubs. Luckily he finds his partner with the Ace, so that yet another card of re-entry is removed.

5. *B* has no winning cards to play. Being in doubt he leads a trump — an old-fashioned rule which has two meanings, and is here necessarily taken with the wrong one.

8. *Y* extracts *A-B*'s last trump, and as *A-B* have no longer a single King card left, *Y-Z* make all the remaining tricks.

Y-Z win the odd trick and the game.

The game should have been played by *A-B* as follows:—

1. D K	D 6	D 3	D 2
2. S 5	S 2	S K	S 4
3. S A	S 3	S 7	S Kn
4. S 8	S 9	S 6	C 2
5. H A	H Kn	H Q	H K
6. C Q	C K	C A	C 3
7. D Kn	D 7	D 10	D 5
8. D A	D 8	D 4	D 9
9. C Kn	C 6	C 7	C 4
10. C 5	C 8	C 9	D Q
11. H 4	S Q	C 10	H 6
12. H 10	H 2	H 5	H 7
13. S 10	H 9	H 3	H 8

1. *A* shows his strongest suit, leading correctly. But then

2. *A* leads trumps, having strength in all the plain suits.

3. *B* returns the highest of two left, so that

4. After this round *A* knows the Queen to be with *Y*. *Z* discards from his worthless Clubs.

5. *Y* leads a strengthening Heart. *B* properly covers, for whatever the new school may say to the contrary the rule until recently followed, to cover an honour with an honour second hand, is much safer than the new rule of passing. In the present case had *B* passed, *Z* would have finessed the Knave, and retained command of the suit.

6. *A* leads from his head sequence in Clubs, hoping to be led to in Diamonds and make his Knave.

7, 8. The finesse comes off.

9, 10. *A-B* make two tricks in Clubs.

11. Force out the trump Queen, and

12, 13. *A-B* make five by cards and the game.

A Difficult Problem.—In Drayson's "Art of Practical Whist" an illustrative case from actual play is thus introduced, p. 102:—"King is turned on your left, and your partner has shown by previous play that he holds Ace, Knave; three cards, trumps, are in each hand." The problem is to determine how, when one trump only has been played, it can possibly be known from previous play that partner holds Ace, Knave! For my own part, I give it up.

Messrs. Harper & Brothers, of New York, have, we see, published an American edition of Miss Ada Ballin's admirable translation of Professor Darmesteter's work on "The Mahdi, Past and Present," which we reviewed on p. 528.

Lord John Manners stated in the House of Commons on Monday, that the new telegraph tariff will, as we anticipated, come into operation on Oct. 1.

The Swan Electric Company has commenced an action against Messrs. Woodhouse & Rawson for infringement of their patents. The action is down for hearing, and will probably be tried in November.

The second annual report of the directors of the Edison and Swan United Electric Light Company, Limited, for the year ending June 30, 1885, states that the accounts show a profit of £12,354. The directors hope to transfer the lamp manufactory from Newcastle to London in the coming autumn. The lamp factory at Newcastle has been working to its utmost capacity. The returns from the Admiralty and other customers as to the duration of life of the lamps supplied by the company are very satisfactory.

Contents of No. 196.

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CONTENTS OF NO. 198.

GEORGE ELIOT ON MENTAL DECAY.

By RICHARD A. PROCTOR.

"The old man says, 'Son, I have swallowed and digested the wisdom of the past.' The young man says, 'Sire, I proceed to swallow and digest thee, with all thou knowest.'"—*O. Wendell Holmes.*

ALTHOUGH none of the unpublished letters relating to the views of George Eliot on old age, and on mechanism in life and thought, have been forwarded to me, I can gather from answers by my friend the acting editor that several readers regard those views as objectionable from a religious or theological point of view. For instance I find the editor at p. 14 reminding a correspondent that George Eliot's dicta were put forth in these columns "as those of a dead woman of the highest literary ability, and of almost world-wide fame (or notoriety)" [!],—he might have said of a dead woman who stands as high above all others living or dead, in literary and philosophical ability, as Shakespeare above all men,—"and neither as arguments nor with any expression of approval. I suppose," he proceeds, "that if I reproduced a conversation here in which Spinoza was an interlocutor, you would accuse me of admitting evidence for Pantheism! You, however, yourself" (he is addressing "H. R. B.") "did unquestionably trench on theological ground, inasmuch as yours was a categorical contention for positive miraculous interference in explanation of a phenomenon of nature."

Well, now, let any want of definiteness as to my own aim and purpose in quoting George Eliot's views be corrected. I quoted them as for the most part the views which in these our times *must* be taken respecting the mechanism of life and thought; as in agreement with all that has been learned about cerebral action and physiological laws; as assuredly needing no approval, because no one who has studied the matter with any degree of care, and with power of forming a just opinion on any subject, can doubt that those views are just; and finally as relating to a matter of purely scientific interest. The idea that such inquiries are to be regarded as relating to matters theological, because this or that person is disposed to deduce such and such inferences in regard to theological questions, is simply absurd. Every one sees the absurdity when the flat-earth man tells us that the doctrine of terrestrial rotundity is irreligious. And I suppose most people would recognise the absurdity of criticism on a treatise upon Epilepsy, that the phenomena described were in former times regarded as due to possession by devils, and have been so described in passages associated with the theological doctrines of Christianity, Judaism, Mahomedanism, Buddhism, and other religions. It is fully as absurd to regard the subject of George Eliot's remarks, introduced among other scientific matter into these columns, as related to religion or theology,—though of course they can be connected, like every earthly thing, with religious matters. Two steps will take the religious enthusiast of the exuberant type (whose religion somehow one always doubts) from Consols to the Gospels. But KNOWLEDGE is not meant for such persons.

I look over everything said by George Eliot and Mr. Lewes in the conversation quoted, and excepting her remark that the moon is a material mirror (which is inexact, but probably Buchanan, rather a careless reporter I imagine, altered what she said) I find absolutely nothing which can even be questioned, far less anything which I should myself oppose. Her remark that the phenomena of old age afford a strong argument against the *popular conception* of a personal immortality is too guarded to be questioned,—and asserts too little to be conceivably offensive even to the weakest brethren. For my own part I regard even the doctrine of a future life as open to scientific discussion, and not necessarily a religious doctrine at all.

But I remember that when Dr. Holmes was writing on the "Mechanism of Mind and Morals" he found it necessary to make a concession to the timidity of those who cannot separate the scientific study of his subject from certain religious ideas which they have been accustomed to associate with it. "We need not," he points out, "be frightened from studying the conditions of the thinking organ in connection with thought, just as we study the eye in its relation to sight. The brain is an instrument, necessary, so far as our direct observation extends, to thought. The 'materialist' believes it to be wound up by the ordinary cosmic forces, and to give them out again as mental products;* the 'spiritualist' believes in a conscious entity, not interchangeable with motive force, which plays upon this instrument. But the instrument must be studied as much by one as by the other; the piano which the master touches must be as thoroughly understood as the musical box or clock which goes of itself by a spring or weight. A slight congestion or softening of the brain shows the least materialistic of philosophers that he must recognise the strict dependence of mind upon its organ, in the only condition of life with which we are experimentally acquainted. And what all recognise as soon as disease forces it upon their attention,

* "It is by no means generally admitted that the brain is governed by the mind. On the contrary, the view entertained by the best cerebral physiologists is that the mind is a force developed by the action of the brain." (Dr. Hammond, in the *Journal of Psychological Medicine*, which he edits.) It will be observed that while George Eliot evidently inclined to this view, it is a matter of no moment so far as the supposed relation of her subject to religion is concerned, whether one view or the other is adopted. The quality of music as such—that is the beauty of its melody and the perfection of its harmony—cannot be regarded as depending on the music being drawn forth automatically or otherwise from the instrument which renders it.

all thinkers should recognise, without waiting for such an irresistible demonstration."

I have given so many examples, in my essays on mental phenomena, of entire change of mental and moral character resulting from injury to the brain or disease affecting it, that it should hardly be necessary for me to say that I myself believe unhesitatingly in the dependence of each man's nature on his physical condition. But I will cite a case which seems to me so striking and instructive that even the most prejudiced—those who *will* see some theologically dogmatic application of every scientific doctrine—can hardly misunderstand its significance.

Two brothers showed, at the age of five and ten respectively, a singularly close attachment. When the elder was sent to school, both children were so unhappy, and became so ill, that, to save their lives, their father brought the elder home again, and a little later sent both to one school. The boys made rapid progress, and "their parents' hearts were filled with thankfulness" by the news they received about the lads' moral and mental qualities. Suddenly, the schoolmaster had to announce an entire change in the character of the elder brother. "He had begun to exercise a very unreasonable and tyrannical authority over the younger; he had been repeatedly punished for it; but although he always promised amendment, and could assign no cause—reasonable or unreasonable—for his conduct, he soon relapsed into his usual habits." The father, after due inquiry, inflicted severe corporal punishment on the elder brother, and confined him to his room for some days with nothing but bread and water for food. The lad earnestly promised amendment. But on his return to school, he presently resumed his misconduct. At last, the father took him away from the school. Severe punishments, long incarceration, and the censure of all his relatives had no effect in changing his disposition. His hatred for his brother increased, until at length the life of the younger was no longer safe from the fury of the brother who had once loved him so well, had "watched him with a kind of parental solicitude, keeping a vigilant eye on the character of the boys who sought his society, and admitting none to intimacy of whom he did not entirely approve!"

A boy who had been exemplary in all his conduct, and actually remarkable for the warmth of his brotherly love, had thus become a monster of cruelty towards his brother who still loved him so much that he would say with streaming eyes, "He might beat me every day if he would but love me; but he hates me, and I shall never be happy again."

But the boy was changed in other ways. At the age of fifteen he was seized by a violent passion for a lady more than forty years old and the mother of five children, the eldest older than himself. There was no depravity about this passion; but its intensity was astounding. His paroxysms of fury when he could not see her became frightful; "he made several attempts to destroy himself; yet in the very torrent and whirlwind of his rage, if this lady would allow him to sit down at her feet and lay his head on her knee, he would burst into tears and go off into a sound sleep, wake up perfectly calm and composed, and looking up into her face with lack-lustre eye, would say, 'Pity me: I can't help it.'"

In old times, the idea of demoniac possession would assuredly have been entertained respecting this boy. He was not mad, though he seemed on the way to madness or to death. But a devil urging him to fury against his brother, and to a wild passion for a lady more than old enough to be his mother, seemed to have taken possession of him. Plato and others of the ancients, ill-informed about physiological matters, would certainly have recognised such a devil, and have striven to cast him forth by such means, physical or moral, as they supposed they were acquainted with. Yet even prayer and fasting would probably have failed, as entreaty and starvation had already failed, in restoring this wicked but once good lad to good and kindly ways.

When, however, a little later, the boy was manifestly becoming idiotic, care for his mind led to a sudden "conversion" which had not rewarded and was not likely to reward the anxiety with which his moral character had been so long viewed. A doctor examined the boy's head, and found a place where the skull was slightly depressed. "The indication is vague," he said, "and we should not be justified in performing the operation for removing a piece of the bone by the trephine, were it not that in this case no harm can be done; the boy must soon die, whether or no." The trephine was applied, and on the inner surface of the part of the skull thus removed, a long spicula of bone was found which had been growing so as to pierce the brain. So soon as this piece of bone had been removed the boy became himself again; his love for his brother returned and his passion for the lady disappeared.* Can it be denied that such a case as this affords the strongest possible argument against the *popular conception* of personal immortality? For here were two entirely distinct personalities,—a kind and gentle one, a brutal and wicked one. Which of these was to be immortal? According to the *popular conception*, as the tree fell it was to lie, for ever. Did the trephine decide between an infinity of happiness and an infinity of misery? Does not a similar objection arise against the *popular conception* of immortality, when the man who has lived a goodly, kindly, and honest life, till old age, becomes weak, spiteful, and dishonest through some decay and degradation of brain substance,—and so dies?

And now, duly to show the real connection, or want of connection, between George Eliot's remarks and religion, I propose to present a conversation similar to that reported by Mr. Buchanan, but with a change of subject. I will call the interlocutors simply A, B, and C; the subject is the wearing out of musical instruments, and "the following suggestive remarks are interchanged":—

A. Were it not better that the instrument whose tones we have learned to love should be destroyed while as yet it has not lost its excellence, than that it should be suffered to grow so worn and old that its tones can cause but discomfort and annoyance?

B. You are right. It is but sentiment which makes novelists speak of the charms of worn-out spinnets and harpsichords. There is nothing so distressing to the musician as the slow and certain wearing out of what has once been a fine instrument.

C. But is not the softening, though it be the weakening, of the tones, beautiful too?

B. Apart from fanciful fallacies not at all. Your favourite poet has correctly spoken of the decay of an instrument as ruinous, of the "rift within the lyre" which, slowly widening, in the end must silence all. Old instruments (even the violin when *really* old) are simply distressing.

* It may be mentioned that the mischief to the skull had been caused by a blow on the head with a hard ruler, given by one of those brutal ruffians who are allowed, for want of due inquiry into their fitness, to undertake the teaching of boys when themselves mere savages. The above narrative is from Dr. Wigan's work on "The Duality of the Brain."

A. Not only do instruments, under circumstances of physical decay, became ranshackly and feeble; when any tone remains it is quite altered. I have heard an old piano, hitherto known as one of sweetest and softest tones, gradually become strident and discordant, and another, once known for its truth and richness, become thin and false. The music we get from an instrument is absolutely dependent on the condition of the mechanical parts. So true is this that the slightest disturbance of the machinery—say, the blocking of a hammer or two—will pervert the entire flow of melody.

C. All this is doubtless very correct. I hold, nevertheless, that the individuality of an instrument is indestructible, despite all temporary aberrations—clouds obscuring the moon's disc, so to speak.

A. Say, rather, disintegrations within the very substance of the moon.

B. And yet, after all, there are musical passages whose beauty seems independent of the material qualities of the instrument.

A. Not one. Moreover, we know that though a functional derangement may be evanescent the structural decay of an instrument is absolute and final. A musical instument once worn out cannot be restored.

C. Then music depends on mechanism after all?

A. Undoubtedly. It depends absolutely on mechanism. To a musical enthusiast like yourself this may seem very pitiful, but it is absolutely true.

B. But how wonderful the mechanism of a fine instrument! how perfect the adaptation of means to ends! Even if we hold music to be a mechanical product, does that lessen the beauty of melodious and harmonious passages?

C. Or the mystery of music's origin.

B. Humph!

A. The mystery doubtless consists only in our ignorance.

C. You offend my musical sense. Can the noble music of Beethoven, Mozart, Rossini, and their fellows, be regarded as mere instrumental products?

A. If you can draw no distinction between music itself and the instrument by which the music is rendered, I fear you are likely to be and to remain offended. Good temper is a physiological product, only seen in perfection when rendered, so to speak, by a healthy body; but does this affect the value of good temper as a quality? So with other virtues. They all depend on the body; yet we do not on that account question their value or propriety.

C. No. That would be absurd; but somehow you do not seem to take a sufficiently high view of music. I wonder what David the sweet Psalmist, or Apollo the god of music, would have said of your doctrine.

A. I imagine that David's ideas about music were somewhat crude. As for Apollo, if he ever existed, his ideas about music were probably cruder still.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

I MUST, in the first place, ask my readers to correct an error in my last paper. The figure given belongs to *Misus cerasi*, the cherry aphis, not to *M. ribis*, the currant one, which I was watching when I made the mistake. The cherry fellow is large and black; the currant one green. I should not again refer to the Aphis tribe but for wonderful accounts in the newspapers of swarms of so-called "flies." Exaggeration in these matters is common in "the big gooseberry season;" but the following from the *Sussex Daily News* of July 23 may not be far out:—

> The village of Emsworth, near Portsmouth, has been visited by a remarkable plague of flies, which simultaneously covered an area of one mile. At some places it was impossible to move without closing the eyes and mouth. Around every lamp in the town the spectacle was most curious. Attracted by the light, thick swarms abounded, and their buzz resembled that of a hive of bees. At the post-office, where the upper portion of the door is open for ventilation, and where necessarily the light is kept burning till the early morning, the insects covered the sorting-boards, letters, and bags, and had to be continually swept off with brushes. At one lamp they simply hung down in clusters. Bicyclists coming from Havant were in several instances compelled to alight, so thick was the swarm; and at the auction-mart at the bottom of the town the tray in which the money was taken was covered an inch thick.

A friend at Portsmouth sent me a squashed specimen, and it proved to be *Phorodon humuli*, the plague of the hop-grounds. Fig. 1, copied from Buckton,

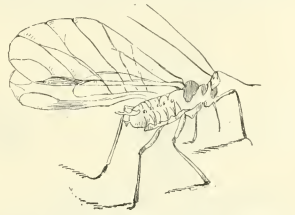


Fig. 1.—Phorodon humuli, winged viviparous female.

represents the winged viviparous female of this species, which develops from the pupa (Fig. 2.). The two little projections from the front of the head characterise the Phorodon genus. The warm, quiet weather of July was favourable to the multiplication of all kinds of aphides, and few gardeners can have escaped a plentiful supply. The swarming in clouds depends upon the wind. The insects, though provided with wings that are very large in proportion to their size and weight, are weak flyers. Their soft bodies, destitute of the hard skin which gives a firm support to the muscles of the powerful flyers, indicate their inability to make much exertion, and in a mild breeze they rather sail than fly. What mischief they do depends on the direction of the air currents in relation to the hop-grounds, and up to the present time the newspapers have not mentioned any ravages corresponding with the enormous numbers of the destroyers seen near Portsmouth and at several other places on the south coast.

It is remarkable that while aphides make a multitudinous appearance in warm summer weather, a cold frosty spring often witnesses a similar sudden swarming of newly-hatched specimens emerging from eggs that can stand extreme cold without injury.

I mentioned in my last that Sanitas supplied a useful wash to keep down these plagues. Those on the cherry-tree were soon killed, and scarcely any fresh ones appeared. A peach-tree was much troubled in June, but sprinkling with Sanitas solution got rid of the first

assailants, and none have appeared since. It is remarkable that although aphides of one species do not seem absolutely confined to one plant, they may swarm for weeks on the one they like best, and not one will go to another tree or plant almost in contact with it. With regard to their various enemies, they unfortunately often fail to appear when they are most needed, and on occasion of a recent search in a kitchen-garden, where many sorts of aphis were enjoying themselves on currant, plum, apple, and other trees, not a single useful opponent could be found. It is interesting to pick off from any leaves the cast skins of any of these creatures, and note the extent of the moulting process. The outer layer of the cornea of the compound eyes comes off like a pair of spectacles, and the integument of the antennæ, and even that of the fine, piercing bristles is also shed. The piercing bristles deserve minute study. When in use, their action must differ from the whip-like cilia of the monads which are lashed about in the water. The slender piercers of the aphides have to be inserted into tissues of considerable resistance, and it is wonderful how those of the *Stomaphis quercus* can be thrust into oak bark. I

Fig. 2.—The pupa from which it was excluded.

Fig. 3.—Rostrum and bristles of Stomaphis quercus.

have not seen it, but take the figure from Buckton's admirable work. An examination of many aphis' bristles with powers up to an oil immersion 1-12, lead me to think the secret may be in their being hollow, so that they can be stiffened by the injection of some fluid. It is clear that if not stiffened those of the oak aphis would be useless as whips.

More than one species may be in the habit of attacking the same plant. Thus Curtis says, three, if not four assail the turnip. The mischief they do often amounts to an immense sum in pecuniary value, and Buckton cites an authority to the effect that the "fly," as the growers call it, lessened the hop duty in 1802 to the extent of £86,000.

I remarked before that the sweet honeydew secretion does not attract bees who may be feeding close to leaves covered with it. To test this matter still further, I put a bee in a wide tube with a leaf quite sticky with the honeydew, and though the insect was detained for several hours, it never touched this kind of sugar. At this time, however, there are plenty of flowers in bloom. Pettigrew states, in his "Handy Book of Trees," that the bees take it in times of scarcity, and that it spoils the honey. Oaks, sycamores, limes, and beeches often yield a large supply.

Paper-Making in Japan.—Scarcely ten years have elapsed since the first paper-mill was started in Japan, with the latest appliances of American and European machinery, and now there are a dozen mills in operation in that country, several of them earning good dividends

MR. DENNING REJECTS HIS METEORIC DISCOVERY.

By Richard A. Proctor.

Mr. Denning and Col. Tupman (on whose authority chiefly, I had accepted Mr. Denning's observations of unchanging meteor-radiants as proved) agree in asserting that the enormous velocities on which I had based my opinion that some meteor systems were ejected from giant suns with velocities far exceeding those formerly recognised, have no existence. I have no objection to this withdrawal from their position. My ejection theory of meteors remains precisely where it did before Mr. Denning announced these persistent radiants, and before Col. Tupman accepted Mr. Denning's results. But Mr. Denning and Col. Tupman must not expect to remain on both sides of the hedge at once. If Mr. Denning's observations of persistent meteor-radiants are sound the enormous velocities which I have endeavoured to explain (my theory will readily explain them, though it by no means needs them) *must* exist; if these velocities do not exist, Mr. Denning has been deceived and Col. Tupman has been misled.

There is positively no escape from one or other conclusion, without rejecting mathematical principles. The matter is not one of theory at all, but of simple geometrical and kinematical facts.

Here is the reasoning, every point in which is incontrovertible, though it may not necessarily be obvious to persons unacquainted with mathematics:—

1. Meteor tracks in the sky represent the real tracks of bodies passing through our air.

2. A set of meteor-tracks radiating apparently from a point are in reality parallel, unless we suppose such apparent radiation a mere accident (an explanation rejected by Mr. Denning and Col. Tupman).

3. When such a radiant remains unchanged in position among the stars, whether hour by hour or month by month, the meteors reach our air from outside,—unless the star-sphere be conceived to be within the earth's atmosphere (which I believe neither Mr. Denning nor Col. Tupman imagines).

4. Where the radiant of a meteor-system remains unchanged for hours the velocities of the meteors of that system must greatly exceed the velocity with which, owing to the earth's rotation, the observer is being carried around the earth's axis.

5. Where the radiant of a meteor-system remains unchanged for months the velocities of the meteors of that system must greatly exceed the velocity with which, owing to the earth's revolution, the observer is being carried around the sun.

Mr. Denning and Col. Tupman assert confidently that no meteors travel with velocities enormously exceeding the velocity with which the earth travels round the sun.

I assert, with the confidence of absolute certainty, that, *if so*, they are utterly mistaken in supposing that there are meteor-systems really radiating for months from the same point on the star-sphere. The coincidences on which Mr. Denning has based his conclusion, and Col. Tupman his support of that conclusion, must unquestionably have been accidental. The contrary may be asserted, just as the flatness of the earth may be asserted, but it is simply impossible that without velocities enormously exceeding the earth's motion of revolution, meteors can continue to radiate from the same point on the star-sphere while the direction of the earth changes —*as it does in three months*—through one right angle.

If Mr. Denning and Col. Tupman prefer to maintain that certain meteor-systems do radiate for months from the same point, well and good—they are in effect maintaining that certain meteors travel with velocities far greater than those due to parabolic orbits round the sun. If on the other hand they prefer to maintain that no meteors have such enormous velocities, that is also well and good—they are in effect maintaining that no meteor-systems radiate for months from the same point. But it is *not* well and good to maintain both these views at once, any more than it would be to maintain at the same time that a substance is both hot and cold, or both solid and vaporous.

MYSTERIES AND MORALITIES.

By Edward Clodd.

IV.

As proclaimed in the Banes, the Chester plays were performed at Whitsuntide.

> As in this citie divers yeares the have bene set out,
> Soe at this tyme of Pentecoste, called Whitsontyde,
> Althongh to all the citie followe labour and coste,
> Yet God guiving leave that tyme shall you, in playe,
> For *three dayes together*, begyninge one Mondaye,
> See these pagentes played to the beste of theire skill;
> Wher to supplye all wantes shalbe noe wantes of good will.

The records of the plays assigned to certain guilds indicate a selection in harmony, as far as possible, with the business of the crafts, as in the performance of the Deluge by the water-carriers of the Dee, and of the Last Supper by the bakers.

Of the particular actors of the Towneley series we know next to nothing, only one or two names of guilds occurring in the manuscript, while of the Coventry our information is derived solely from the guild records, from which the more important excerpts are given in Mr. Sharp's *Dissertation on the Coventry Mysteries*, published in 1825. But the Chester Banes furnish us with a fairly complete guide to the guilds acting the plays in that city, and in the archives of York there is preserved a book dating from the year 1376, temp. Edward III., and containing, under date 1415, a complete list of the plays and the crafts to which they were severally allotted. Comparing a few of the York and Chester together, we have as follows:—

	York.	Chester.
The Creation and Fall of Lucifer	Barkers (*i.e.*, of trees)	Tanners.
Adam and Eve in Eden*	Fullers	Drapers.
Building of the Ark†	Shipwrights	
Noah and the Flood‡	Fyshers and Marynars	Water-leaders, Drawers of Dee.

* In Dublin by the Glovers.
† In Newcastle-on-Tyne by the Shipwrights.
‡ In Dublin by the Mariners and Vintners.

	York.	Chester.
Abraham's Sacrifice	Parchmyners and Bokebynders	Barkers, Waxe-Chaundlers.
Coming of the Three Kings*	Goldemyths	Merchant Vintners
Massacre of the Innocents	Gyrdillers and Naylers	Gouldesmythes.
Temptation of Jesus	Smythis	Buchers.
Entry into Jerusalem	Skynners	Corvisors (Shoemakers.
The Last Supper	Baxteres (Bakers)	Bakers.
Crucifixion†	Pynners and Paynters	Fflechers, Bowyers, Coopers,§ Stringers, and Ironmongers.
Harrowing of Hell‡	Sadilleres	Cookes.
Resurrection‡	Carpenters‖	Skynners.
Travellers to Emmaus	Sledmen (Porters)	Saddlers.
The Judgement	Merceres	Weavers.

The Coventry series, like the Chester, is preceded by a proclamation giving metrical lists of the several plays.¶ The Chester "vexillator," or herald, prefaces his "banes" with several stanzas before reciting the subjects and bidding the players take their places, but the Coventry prologue, which was delivered by three heralds, starts with the briefest announcement to

> Gentyllys and Zemanry of goodly lyff lad,
> This tyde,
> We xal you shewe, as that we kan,
> How that this werd ffyrst began,
> And how God made bothe molde (earth) and man,
> Iff that ze wyl abyde.

Space permits the quotation of only a few verses from the two prologues for purposes of comparison, showing the fuller and more poetical form of the Coventry, which is also the most elevated in tone and dignity of the four collections.

Chester Banes.

> Nowe, you worshippfull tanners, that of custome olde
> The fall of Lucifer did sett out,
> Some writers awarrante your matter, theirfore be boulde,
> Erstelye to playe the same to all the rowtte;
> And yf any thereof stande in any doubte,
> Your authour his authour hath, your shewe let bee
> Good speech, fyne players, with apparrill comelye.

Coventry Banes.

> In the ffyrst pagent, we thenke to play
> How God dede make, thorowe his owyn myth,
> Hevyn so clere upon the fyrst day,
> And therin he sett angelle fful bryth.
> Than angelle with songe, this is no nay,
> Xal worchep God, as it is ryth;
> But Lucyfer, that angelle so gay,
> In suche pompe than is he pyth,
> And set in so grete pride,
> That Goddys sete he gynnyth to take,
> Hese lordys pere hymself to make,
> But than he ffallyth a ffend ful blake,
> Ffrom hevyn in helle to a [bide].

Chester Banes.

> The appearinge angell and starr upon Christes beirth
> To sheapheards poore, of base and lowe degree,
> You painters and glasiors decke out with all meirth,
> And see that *Gloria in excelsis* be songe merelye.
> Fewe wordes in that pageante makes meirth truely,
> For all that the altar had to stande uppon,
> Was glorye to God above, and peace one earth to man.

* In Coventry by the Shearmen and Taylers.
† In Coventry by the Smiths.
‡ In Coventry by the Cappers.
§ Trades connected with archery; the fflechers fixed the feathers on the arrows.
‖ In Dublin the House Carpenters performed "The Buriall of Christ."
¶ No prologue has survived with either the York or Towneley series.

COVENTRY BANES.

In the xvj pagent Cryst xal be boro,
Of that joy aungelys xul synge,
And telle the shepherdys in that morn
The blysseful byrth of that Kyng.
The shepherdys xal come hym befforn,'
With reverens and with worchepyng,
Ffor he xal savyn that was forlorn,
And graunt us lyff evyn more lestyng,
I wys,
This gle in grythe
Is mater of myrthe,
Now Crystys byrthe,
Bryng us to his blys!

CHESTER BANES.

And nexte to this, you, bowchers of this citie,
The storie of Sathan, that Christe woulde needes tempte,
Set out as accostamablie have yee
The devill in his fethers all ragger and rente.

COVENTRY BANES.

In the xxth pagent alle the develys of helle,
They gadere a parlement, as ye xal se,
They have grete doute the trewth to telle,
Of Cryst Jhesu whath he xulde be.
They sende Sathan, that ffynde so ffelle,
Cryst for to tempte in fele degré:
We xal yow shewe, if ye wyl dwelle,
How Cryst was temptyd in synnys thre
Of the deyvl Sathane;
And how Cryst answeryd onto alle,
And ma[illegible] the ffende awey to falle,
As we best may this shewe we xalle,
Thorwe grace of God and man.

CHESTER BANES.

You, ffletchers, boweyers, cowpers, stringers, iremongers,
See soberly ye make of Christes dolefull death,
His scourginge, his whippinge, his bloude shedde, and
And all the paines he suffered till the last passion of his breath:
Lordinges, in this storye consisteth our cheeffe ffayth.

COVENTRY BANES.

In the xxx pagent thei bete out Crystes blood,
And nayle hym al nakyd upon a rode tre,
Betwen ij thevys, i-wys they were to wood (very mad)
They hyng Cryst Jhesu, gret shame it is to se.
Vij wurdys Cryst spekyth hangyng upon the rode,
The weche ye xal here alle tho that wyl ther be,
Than doth he dye ffor oure allether* good;
His modyr doth se that syth, gret mornyng makyth she,
Ffor sorwe she gynnyth to swowne.
Seynt John evyn ther as I yow plythe,
Doth chere oure lady with al his mythe,
And to the temple anon forth rythe,
He ledyth here in that stownde (time).

CHESTER BANES.

As our beleeffe is that Christe, after his passion,
Descended into hell, but what he did in that place,
Though our authour sett fourth after his opinion,
Yet creditt you the best learned, those doth he not disgrace:
We wishe that of all sortes the beste you ymbrace;
You, cookes, with your carriage see that you doe well
In pagente sett out the harrowinge of hell.

COVENTRY BANES.

In the xxxiiij pagent xal Maryes thre
Seke Cryst Jhesu in his grave so coolde;
An aungel hem tellyth that aresyn is he;
And whan that this tale to them is tolde,
To Crystes dyscyplis with wurdys ffful fre,
They telle these tydynges with brest ful bolde.
Than Petyr and John, as ye xal se,
Down rennyn in hast over loud and wolde,
The trewth of this to have.
Whan thei ther comyn, as I yow say,
He is gon ffrom undyr clay,
Than ther wytnesse anoon that day,
He lyth not in his grave.

* Genitive plural of *all*.

The last verse of the Chester Banes, after citing the words of Jesus to the righteous at Doomsday, closes with lines touching in their simplicity, and in the prayer for the salvation of the spectators which they utter:—

To which rest of wayes and selestiall habitation
Grante us free passage, that all together wee,
Accompanied with angells and endlesse delectation,
Maye contynually laude God and prayse that King of Glorye.

The Coventry prologue ends with a prayer and business announcement in combination, reminding us of the notices from modern pulpits accompanying the benediction:—

Now have we told yow alle be-dene (obediently)
The hool mater that we thynke to play;
Whan that ye come, ther xal ye sene
This game wel pleyd in good aray.
Of holy wrytte this game xal bene,
And of no fablys be no way,
Now God them save from trey and tene (trouble and harm)
Ffor us that prayth upon that day,
And qwyte them wel ther mede.
A Sunday next, yf that we may,
At vj of the belle we gynne oure play,
In N. towne, wherfore we pray,
That God now be youre spede.
Amen.

In all the pageants of the *Creation* the exceedingly popular legend of the fall of Lucifer from heaven* was introduced. God appears, declaring himself

Alpha et o
The first and last also:
One God in trinyte,†

and receives the adoration of the angels, who sing "Holy, holy, holy, Lord God of Sabaoth" before him. That the plays were accompanied by music is evident from the stage directions, and from the pieces collected both by Mr. Sharp and Miss Toulmin Smith, as also from the entries in the records of the Coventry guilds extracted by the former. *E.g.*—

1451. Itm. payd to the mynstrells viii s.
1471. Itm. spend on mynstrells dinr and thr sop on Corps x^t day xx^d.
1477. It.' payd to the wayts for pypyng v s.
Itm. payde to hym that playde on the flute ii s, vi d.

But the specimens have neither much melody nor value, and can only be imperfectly translated from the old notation into modern signs of semibreves, minims, and the like. After the angels' song, God descends from his seat and goes out, whereupon Lucifer usurps his throne and demands the worship of the angels.‡ The loyal and rebellious disagree, and the dispute is ended by the return of the Deity, who casts the arch-traitor and his followers from heaven.

Deus. Thus Lucyfere ffor the mekyl pryde,
I bydde the ffalle from hefne to helle;
And alle tho that holdyn on thi syde,
In my blysse nevyr more to dwelle.
* * * * *
Lucyfer. At thy byddyng thi wyl I werke,
And pas fro joy to peyne smerte,
Now I am a devyl ful derke
That was an aungelle bryht.§

* Partly based on Isaiah xiv. 13, 14; Revelations xii. 7–9; and the words of Jesus, "I saw Satan like lightning fall from heaven," Luke x. 18. In his fall to the abyss of hell he broke his leg like Hephaistos when hurled from heaven by Zeus, and hence in Aryan myths the legend of the lame devil (*diable boiteux*).

† In the Chester variant the Deity asserts his power and glory in alliterative rhyme, and calls himself "Prince principall proved in my perpetuall provydence."

‡ Hic Deus recedit a suo solio et Lucifer sedebit in eodem solio. —*Towneley Mysteries.* "Creatio," p. 3.

§ *Coventry Mysteries*, p. 21.

The arrangement of the *Creation* differs somewhat in each of the series: in the York, where it fills a cycle of six plays, God has made the earth before Lucifer's expulsion, and since it grew dark when "the fendes fell," he divides the darkness from the light, and then creates the host of heaven and all living things, from "erbys and also othyr thyng" to "man like vn-to me." In the Towneley, the fall of Lucifer is interposed between the creation of all things and of Adam and Eve, who are led by the Cherubym to Eden and forbidden to touch the "tre of life." In the Coventry variant, the creation of everything, save the heaven where God and his angels dwell, follows the expulsion, and to Adam and Eve are given "paradys" with "flesche and ffysche and frute buxum (obedient) at their byddyng."

> Here is pepry, pyan, and swete lycorys,
> Take hem alle at thi lykyng,
> Both appel and pere and gentyl rys (boughs)
> But towche nowthe this tre that is of cunnyng.

There can be little doubt from the evidence of the stage directions, and the references of opponents of the plays, that Adam and Eve appeared upon the stage naked. In the Chester series it is stated that they *stabunt nudi, et non verecundabuntur*, and another marginal direction, when their fall is performed, is that they shall cover *genitalia sua cum foliis*.*

* Some slight covering must, however, have been worn by the impersonators of women's characters, as female performers did not appear on the English stage till 1629. Under date of Jan. 3, 1661, Pepys records: "To the theatre, where was acted 'Beggars Bush,' it being very well done; and here the first time that ever I saw women come upon the stage."

INFLUENCE OF MECHANICAL INVENTION.

IN a recent issue of *Bradstreet's* the subject of "Progress in Manufacturing" is touched upon, and it is shown by reference to researches of Mr. Edward Atkinson to what extent the world is indebted to mechanical invention for the great abundance of useful commodities. The result is shown in a clear manner by the aid of charts. For the purpose of illustrating his argument or theory, Mr. Atkinson selected, among other industries, the manufacture of cotton sheetings, comparing the prices and other figures of 1840 with those of 1883 and 1885. The data were obtained from two mills which have always been successful.

In 1840 the product of cotton sheetings per hand per year was 9,600 yards, while in 1883 it was 28,032 yards, an absolute increase of 190 per cent. in efficiency of labour growing out of improvements in machinery.

In 1840 the number of spindles was 12,500; in 1883 it has increased to 30,800, an increase of 146 per cent.

The value of product per head in 1840 was 868 dols.; in 1883 it was 1,973 dols., an increase of 127 per cent.

The rate of wages per hour in 1840 was 4·49 cents. In 1883 it was 8·80 cents, an increase of 96 per cent.

The rate of wages per year was 175 dols. in 1840, and in 1883, 287 dols., an increase of 64 per cent.

The number of operatives in 1840 was 530, in 1883, 527; remaining about the same, while the increase in machinery was about 186 per cent.

The hours of labour were thirteen in 1840, and eleven in 1883, being a reduction of about 15 per cent. In 1840 the price of cloth was about 9 cents, while in 1883 it had been reduced to about 7 cents, being a reduction of about 22 per cent.

Estimating the proportion of price to profit on fixed investment at 10 per cent., the profits in 1840 were 1·18 cents, in 1883 0·43 cent, being a decrease of 80 per cent. in the proportion of the product assigned to profit.

Mr. Atkinson has summarised the progress as follows:—

"Fifty years ago the average earnings of all the operatives in a large cotton-mill, who were worked thirteen hours or more a day, and among whom were comprised a much larger proportion of men than at the present time, while the women were older and there were fewer children, were 2·50 dols. and 2·62 dols. per week. The quantity of machinery which each hand could tend was much less; the production of each spindle and loom was less; the cost in money of the mills per spindle or loom was much greater, while the price of cloth was at times more than double the price at which it can now be sold with a reasonable profit. The average earnings of all the female operatives in what purports to be the same factory, at the present time, on the same fabric, working ten or eleven hours a day, are 5 dols. per week, and in some cases even 6 dols. or more to the most skilful. That is to say, women now earn about twice as much in ten hours as men and women combined averaged in thirteen hours then. The course of events has been as follows:—A continuous reduction in the hours of labour, coupled with an increase in the earnings per hour; a diminution in the ratio of capital to production, coupled with an increase in its productive efficiency; a constant increase in the supply of cotton fabrics *per capita*, coupled with a decrease in the price; a continuous increase in the purchasing of gold dollars in respect to almost all articles of necessary subsistence."

It is pointed out that these facts afford a complete demonstration of the fallacy that high wages and high cost of production are synonymous; that the rate of wages is only one of many elements instead of the single important element in determining the cost of production in any industry; that it is quite possible that the highly-paid labour in our best cotton-mills costs less per pound or yard of product than the "pauper labour" in English mills, and that if the obstacle of obstructive tariff taxes on sundry things which they have to use were cleared away, American manufacturers would be more than able to hold their own.

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

THE ROCKS OF THE LICKEY.

(*Continued from page* 71.)

TWELVE miles south-west of Birmingham there rises the little rocky ridge called the "Lower Lickey," which it is the object of this paper to describe. The Midland line from Birmingham (New-street) to Worcester and Gloucester touches the south-east end of the Lickey at the small station called Barnt Green; or we can reach the north-western extremity of the ridge by the Great Western line (Birmingham, Snow-hill station), which will take us *viâ* Old Hill and Halesowen to Rubery. A good plan is to go by Great Western to Rubery, examine the country, and return from Barnt Green by the Midland line.

Getting out at Rubery [see Map (1)], the visitor finds himself in front of a grand section exposed by the railway-cutting, which shows the typical rock forming the

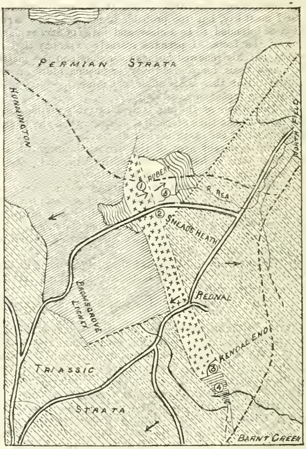
little line of hills he is about to examine. Here the strata have a slant or "dip" to the south-east of about thirty-five degrees, and they rise vertically in the cutting to a height of forty feet. The rock is a quartzite—a very old, altered sandstone. Under the microscope, the original grains of sand are still discernible in thin slices of the rock, but they are compacted together by an interstitial deposit of silica, left behind—ages ago—by heated water, which then soaked through the stone. Here and there specks of whitish decomposed felspar are visible in hand specimens. The tint of the stone is a greyish or pinkish white, but in some of the quarries at the southern end of the ridge a darker, redder tinge prevails. The rock is very much jointed, so that it is impossible to get a sound lump of stone of any size. For this reason it cannot be worked into square "setts" for paving, but is simply broken into small rubble, which is used for mending the local roads. No trace of any fossil has ever been found in the quartzite proper, and lithologically it is indistinguishable from the quartzite of Nuneaton, which we lately described (p. 71), and from that of the Wrekin, of which we hope to speak in another article.

Geology owes much to railways. The cutting at Rubery shows a capital section of a "fault," by which the rock has been raised on one side of a crack or fissure some eight or ten feet above the corresponding bed on the other side. The "fault" here is clear as a diagram; but of the many such hidden dislocations by which this region is traversed, several of which have displaced the strata, not tens, but hundreds, or it may be thousands of feet, we can generally only infer the existence, actual sections crossing and exposing the line of fault being, as a rule, wanting.

Walking now to the south-east, over the first hummocky elevation which lies before us—Rubery Hill—we note other quarries on the road-side in which the strata lie nearly horizontally, and at last they curve over and dip to the west, showing that the structure of the Lickey ridge is that of a broken anticlinal or saddle. A few minutes' walk brings us to a valley crossing the ridge, and coinciding with a line of fault. Lines of fault are very frequently lines of weakness, for the rock on either side of the actual line of dislocation is almost certain to be more or less broken, fissured, and thereby weakened. The agents of denudation—the rain, rivers, frost, and ice—take advantage of this breaking-up, and erode the rocks along the fault-line, so that it is converted into a valley or ravine, whose bottom may be traversed by a stream, or filled up with débris and covered with vegetation. This is one reason why clear sections, showing the actual course of a fault, are not of more common occurrence.

Coming into the main road, which takes advantage of the break in the ridge, we see another quartzite quarry in front, while the gates of the large new Lunatic Asylum are close at hand on the left. The roadside wall opposite the Asylum gates is composed of a reddish friable sandstone, quite different from the hard quartzite of the hills, and a little search is sufficient to discover on the rocky slope beyond the wall the junction of the two rocks. [See Map (2).] The quartzite is clearly the older of the two, for the sandstone rests upon it and fills up hollows and pockets as if it had been deposited on a sloping shore; moreover, it contains at its base well-rolled lumps of the metamorphic rock as large as one's fist.

A little search reveals the fact that the sandstone is crowded with fossils, which are chiefly casts of a brachiopod shell called *Stricklandinia lirata*, together with a *Pentamerus*, and a little coral, *Petraia bina*. These fossils enable us to refer the sandstone to the Upper Llandovery Beds (or *May Hill sandstone* of Sedgwick) which are elsewhere known to form the base of the Upper Silurian Formation. But the quartzite is of early Cambrian, or even possibly of pre-Cambrian age, so that there is a time-break between the two strata of enormous magnitude. The quartzite was deposited as a sandstone, metamorphosed into a quartzite, and elevated to form a sloping, uneven sea-bottom or shore before the Llandovery sandstone was deposited upon it. The dip of each set of rocks is now to the eastward, but the angle of dip of the quartzite is much greater than that of the sandstone.



Geological Map of the Lower Lickey Hills.—Quartzite. Coal Measures. Permian. Trias. Silurian. Pre-cambrian. Prevailing dip shown by arrows ↘.

Crossing the road at this spot, which rejoices—or rejoiced—in the name of Snead's Heath, we enter the Asylum grounds [see Map (5)], and turn sharply to the right through a small plantation, across which a little brook—one of the sources of the Rea—has cut a channel, with vertical sides some ten feet deep. Along this brook-course are exposed the Silurian shales and limestones which rest upon the Llandovery sandstone. The thin limestone bands here contain numerous and well-preserved fossils, which prove them to be the equivalent of the Woolhope or Barr limestone. Searching still further to the east, the coal-measure shales which cover the Silurians are found, and beyond and upon all come Permian

and Triassic strata, which encircle the little rocky eminences of the Lickey like the waves round a lonely ocean isle.

(*To be continued.*)

THE RUDDY ECLIPSE OF THE MOON.

By Richard A. Proctor.

THAT Mr. Williams would "still fail to understand how the sun can be *all* refracted and *all* brought above the earth's horizon and *all* thus seen from the moon," yet the moon be in shadow as compared with her state when the earth is not in the way, seemed, I fear I must say, but too probable to me, even as I wrote what I intended to be a clear and satisfactory explanation of the facts. I perhaps scarcely expected that he would put his renewed failure to understand the matter as a new basis for his entirely erroneous ideas on the subject. But that is his affair, not mine.

I simply repeat or state that,

1. The whole of the sun is demonstrably visible from the moon at the time of central eclipse, when the bounding horizon of the earth is clear of clouds.

2. The apparent area of the distorted image of the sun thus seen is less than one-880th of the area of the apparent disc of the sun when not eclipsed.

3. Apart from absorption the image cannot have an intrinsic brightness greater than that of the sun himself.

4. Absorption acts effectively to reduce the lustre of the distorted image of the sun seen from the moon.

5. Usually, too, a portion of the earth's bounding horizon is clouded. Therefore

6. The total amount of light falling on the moon during central eclipse is much less than that falling on the moon at other times.

7. This is the accepted explanation, as normally understood.

If Mr. Williams will be at the pains to look at the sun through a telescope or powerful opera-glass, the wrong way,—that is, through the larger end—he will find that *all* the sun is thus seen, yet without radiating to his eye *all* the normal amount of luminous or calorific energy *minus* of course that absorbed by the glasses. Again if on a bright and sunny day he will be at the pains to set up a telescope, or to hold a powerful opera-glass towards the sun, with the small end nearest to that luminary, but the optical axis carefully directed towards the sun, and then place a piece of white paper or card so as to receive those rays from the *whole* sun which the former experiment shows to be shining down the telescopic tube or through the opera-glass, he will find that the part of the card so illuminated is very manifestly in shadow as compared with the part outside. The shadow is not black, but it is very dark, and the greater the power of the telescope the darker is the shadow, corresponding to the circumstance that the greater the power of a telescope through which we look the wrong way at the sun the farther away—that is, the smaller—he looks. Yet once more, if Mr. Williams will look at the sun or moon or any luminous object through a telescope with one eye, while with the other he looks directly at that object, he will find that whether he looks through the right end or the wrong end (he could only look at the sun through the right end when the sun's light is much dimmed by fog or haze) the image seen through the instrument *never* looks brighter than the object seen directly. It may give more light, looking larger or nearer, but it never looks more brilliant intrinsically. Consequently, if it looks very much smaller, very much less light is received from it.

This again is an accepted law,—because it happens to be a demonstrated fact. The explanation is that which I have given in my essay on the Laws of Brightness.

The law is true whether the image seen is distorted or not.

A similar law applies in the case of reflexion. The total solar radiation (less loss at reflexion) is in a sense received from the minute image of the sun seen in a convex mirror; but it is received in such a way as to spread more widely, and consequently the total amount received by the eye pupil, or by any given surface exposed to this radiation, is very much less than that received directly from the sun.

The rays of the sun which fall on the zone of our air above the earth's horizon, as seen from the moon, are deflected in such varying degrees according to the height of the layer through which they pass, that they are in a sense diffused, so as to be spread—like water from a rose—over a very much larger region than they would otherwise illuminate. They illuminate, therefore, the region on which they fall very much less strongly,—or in other words that region is in dark (though not black) shadow.

The focus of a pencil of sunlight coming through the earth's atmosphere in such a direction as to fall, after deflection, on the moon's surface, lies—not where Mr. Williams has imagined, between the earth and moon, but—many many millions, nay many hundreds of millions of miles beyond the sun. Thus if an eye were at the moon's surface to receive a part of that pencil after refraction through the earth's atmosphere, it would get but a very small allowance of light from it. So with other pencils from other parts of the sun's surface. The moon's surface then would assuredly (by which I mean demonstrably and calculably) be in dark though not absolutely black shadow, even if the earth's atmosphere were perfectly clear.

Mr. Williams' version of the accepted explanation is *not* as he imagines "that given by Sir John Herschel," who assuredly does not "ascribe the ruddy hue of the moon to the *twilight* glow of our atmosphere." Sir John Herschel says on the contrary that the lowermost strata of our atmosphere "impart to all the rays they *transmit* the ruddy hue of *sunset*, only of double the depth of tint which we admire in our glowing sunsets, by reason of the rays having to traverse twice as great a thickness of atmosphere." The *twilight glow* and the *glow of sunset* are two entirely different things. The sun owes his ruddy glow when setting to the rays which our atmosphere transmits; the glow of twilight is due to rays which are not transmitted, but reflected and dispersed. The lower strata of the atmosphere in their normal state (I mean as to matter suspended in them or diffused through them) transmit red, orange, and yellow rays more freely than green, blue, indigo, and violet rays. Hence the setting sun usually looks ruddy (this beyond question is what Herschel refers to when he speaks of the ruddy hues of sunset). When these red rays of the sun fall on clouds, or rocks, or icebergs, or any substance capable of reflecting or dispersing them they make that substance look red. This ruddy reflected or dispersed light is what we see in twilight. But if Herschel had regarded this twilight glow as the cause of the ruddiness of the eclipsed moon, he would not have spoken of double the depth of tint by reason of twice the depth of atmosphere being traversed; for the more of this twilight colour in our air

the less tint could get through to the moon, and Herschel distinctly speaks of the tint as transmitted. When recently the twilight glows were particularly ruddy the sun himself looked greenish.

It should not be necessary, I need hardly say, for me to defend Sir John Herschel's explanation against Mr. M. Williams's interpretation, which in reality reduces it to something scarcely distinguishable from absurdity. What Herschel really says, is,—that our atmosphere, which through its normal absorptive power makes the sun look red when setting, must make him—that is, his distorted image—look doubly red as (supposed to be) seen from the moon; for while *we* see the setting sun through a certain range of our atmosphere, the imagined lunarian would see the sun (much reduced in apparent size and strangely distorted in shape) through double that range.

Mr. Williams must really not ask any one who understands the accepted and demonstrable interpretation of the ruddy eclipsed moon, to permit the existence (as a live creature) of that straw giant which he first set up as "the accepted theory expressed by Sir John Herschel" and then triumphantly proceeded to slaughter in the *Gentleman's Magazine*.

That was all I cared to state (to Mr. Williams), and to explain for any who might not happen to have understood clearly what the accepted explanation is, but at the same time possessed ufficient knowledge of optics and physics, and sufficient patience, to follow and grasp the considerations actually involved in the matter.

The self-glowing tufaceous matter may be left to itself. I know no reasons for supposing that the moon's surface is tufaceous, but many for supposing otherwise; I can see no reason for supposing that "a tufaceous lunar surface if it existed would become self-luminous under solar radiation," but on the contrary I find evidence, in the thermometric observations on the last total lunar eclipse visible in England, apparently demonstrating the reverse. But I do not think the theory wants killing.

As for Mr. Williams's figures, I can only say that all experiments yet made in the way of measuring the moon's radiation of heat are entirely inconsistent with them. So much the worse, he may think, for the experiments. I take a different view.

I object to Mr. Williams's statement that I and others *accepted* his views about Jupiter, Saturn, Uranus, and Neptune. I published the views which I at present hold about Jupiter and Saturn, and the evidence—chiefly observational—on which I based them, in lectures delivered before the Royal Institution at Manchester (the syllabus of each lecture is preserved in the records of that institution), several months before the "Fuel of the Sun" was published. It was in that work that Mr. Williams published his views. How long he had entertained them, or perhaps talked about them, before, I do not know. But I know that I had never heard of his holding them, till long after I had publicly discussed them.

I do not say this as caring two straws about priority in the matter. I have always pointed out that Buffon came long before any of us in the idea that Jupiter and Saturn are fiery-hot planets. And very likely others preceded him. Sir Isaac Newton certainly showed long before Buffon that larger masses are longer than smaller ones in cooling. But while only children and simpletons are concerned about priority in such matters, I emphatically object to being described as accepting Mr. Williams's views, in presence of the fact that I have never referred to him as having in the slightest way or degree suggested the views I hold. If I *had* borrowed from him, my whole conduct in the matter would have been excessively mean, and therefore exceedingly foolish. I object to being presented as either one or the other.

Let me remark, in conclusion, that Mr. Williams twists a remark of mine quite out of its real meaning when he represents me as saying that "19-20ths of his 'Fuel of the Sun' is out of the pale of science." Every one would understand that to mean that I considered nearly the whole of his book as unscientific, as inconsistent with known scientific facts. My actual words were very different, and could not be understood in that sense,—I said "I doubt even if 19-20ths of my friend's 'Fuel of the Sun' must not be regarded as outside the fairly-defined limits of the field of knowledge." I am satisfied that no one understood me to mean more than that some such portion of Mr. Williams's theories must be regarded as not representing known truths. His hypotheses are for the most part not proven; but this is not saying that they may not be proved; and still less is it saying that they are contrary to knowledge.

Mr. Williams may rest assured that if one-twentieth of the new ideas in his book shall come to be regarded as established truths, the work is well worth the praise which—he tells us—Sir Charles Lyell gave to it. Considering that many of even Newton's ideas about physical matters have not only not been established or confirmed, but have been definitely disproved, Mr. Williams could hardly hope to be right all through or even in the greater part of his work; still less could he expect his hypotheses to be *already* regarded as established truths,—that is, within the fairly-defined limits of the known.

Mr. Williams might have added that "the idea prophetically suggested by Sir Isaac Newton" was widely known at the time when it was started, and (unlike Newton's theory of gravitation) was somewhat profusely ridiculed.

TRICYCLES IN 1885.

By John Browning.

(*Chairman of the London Tricycle Club.*)

UNSAFE TYRES.

SOME years ago a distinguished man of science committed suicide. No light could be thrown on the cause for his doing so. Speaking to a well-known physician on the subject he said the suicide was caused by suppression, "the man had never given vent to his feelings." Now as I do not wish to die of suppression, I propose to express my feelings freely on the subject of unsafe tyres.

Rubber tyres ought clearly to be made to stick firmly on to our wheels, but they are now generally made to come easily off. Considering that a tyre is most likely to come off when the machine is running down a steep rough hill, it is wonderful to me that we have not had more accidents from this source than have happened.

Riding one day along the Brighton road, I saw a strange object coming towards me, which looked like a small cart with the wheels uppermost. On coming closer I found that it was a gigantic labourer holding a tricycle, with 50 in. wheels, at arms'-length above his head, and in this manner carrying it along the middle of the road. "That's a bad job," said I, as he was passing by. "Not for me," said the giant, grinning from ear to ear; "it will get me and my kids a dinner to-morrow." "Where's the rider?" said I. "They've put him in the train at

the Junction," said he, "and I am carrying this to Krydun (Croydon) to be set to rights."

Then he explained in his own way that one of the tyres had come off when running down a hill, and, catching in the chain, had suddenly stopped the machine, making it turn several somersaults. The rider was badly injured, and the machine was so bent, torn, and damaged that it could not be wheeled, and I would never have trusted it again had I been the owner, no matter who might have repaired it.

Since hollow rims have come into use tyres have come off more frequently than before. This arises from the fact that the rims are shallower than the solid rims were, that the cement runs away through the holes made to receive the heads of the spokes, and that it is difficult to make the rim hot enough to melt the cement without unsoldering the rim.

The most frequent cause of loose tyres is, however, that the makers finish and paint, or enamel the machines before they put on the tyres, and they are afraid afterwards to make the rims hot enough to melt the cement for fear of blistering or damaging the appearance of the paint or enamel. The rims are mostly only just warmed sufficiently to make the tyres adhere, and a few miles run over a rough road will soon loosen them or bring them off.

To ensure the perfect adhesion of tyres, the surface of the tyres should be cleaned with turpentine, or, better still, seared with a hot iron; the rims should be well coated with a good tough cement (Loudon's is the best I have tried), and should then be heated until the cement runs out of each side of the rim, and the tyre should be well knocked down with the palm of the hand while the cement is hot. If the utmost security is desired the tyre should be bound round, not too tightly, with a broad tape, which should not be taken off for several hours.

When the tape is removed the superfluous cement should be cut or scraped away, and then, and not before, the wheel should be painted or enamelled.

Tyres put on as I have described should—if the cement used has been good—adhere firmly until they are worn out.

The truth is, that the method of fixing our tyres on simply by means of cement is a miserable makeshift, with which we ought not to rest satisfied. It necessitates the tyre being smaller in diameter than the rim, so that it shall be stretched on. The result is, that every slight cut opens more and more, until it becomes a gash, which almost divides the tyre. By rights, the tyre should be compressed into the rim, then a cut would go no further. Timberlake threaded the tyre upon a stout wire and compressed the tyre into the rim. As I have seen tyres made on this plan, which I was assured had run over 10,000 miles without coming off, and which were then nothing like worn out, I cannot think why this plan has not been more generally adopted.

A few months since, Warwick, of hollow rim fame, advertised a special rim and tyre, in which the top edges of the rim were turned over on each side inwards, and these edges fitted into grooves in the sides of the tyre. Once in the rim these tyres, I am told, could not be dislodged unless proper tools were used for taking them out, but I have not been able to see any of them in use. Why not?

British and American Steel.—In 1883 Great Britain produced 76,035 more tons of Bessemer steel than the United States. In 1884 matters were reversed, the United States producing 74,531 tons more than Great Britain.

ODD SUPERSTITIONS.

STRANGE NOTIONS OF PEOPLE IN VARIOUS COUNTRIES CONCERNING MATRIMONY.

THERE is, perhaps, no period in a woman's life that so completely changes her whole existence as marriage, and for that very reason she is apt to be more superstitious and fanciful at that time than at any other; and while superstitions are fast becoming a something of the past, there are very few women who will not hesitate before making Friday their wedding-day, or will not rejoice at the sunshine, for "happy is the bride the sun shines on." June and October have always been held as the most propitious months in the twelve—a happy result being rendered doubly certain if the ceremony was timed so as to take place at the full moon, or when the sun and moon were in conjunction.

The Romans were very superstitious about marrying in May or February; they avoided all celebration days, and the calends, nones, and ides of every month. The day of the week on which the 14th of May fell was considered very unlucky in many parts of "merry old England," and in the Orkney Islands a bride selects her wedding-day so that its evening may have a growing moon and a flowing tide. In Scotland the last day of the year is thought to be lucky, and if the moon should happen to be full at any time when a wedding takes place the bride's cup of happiness is expected to be always full. In Perthshire the couple who have had their banns published at the end of one and are married at the beginning of another quarter of a year can expect nothing but ends.

The day of the week is also of great importance, Sunday being a great favourite in some parts of England and Ireland. And although an English lass would not marry on Friday, the French girl thinks the last Friday in the month particularly fortunate. Most of us know the old saying concerning the wedding-day :—

Monday for wealth,
Tuesday for health,
Wednesday the best day of all;
Thursday for crosses,
Friday for losses,
Saturday no luck at all.

In Yorkshire, when the bride is on the point of crossing her father's threshold, after returning from church, a plate, containing a few small pieces of cake, is thrown from an upper window of the house by a male relative. If the plate is broken, she will be happy; if not, she will not expect to escape misery.

In Sweden a bride must carry bread in her pocket, and as many pieces as she can throw away just so much trouble does she cast from her; but it is no luck to gather the pieces. Should the bride lose her slipper, then she will lose all troubles, only in this case the person who picks it up will gain riches. The Manxmen put salt in their pockets and the Italians "blessed" charms.

It is an unhappy omen for the wedding to be put off when the day has been fixed, and it is believed much harm will ensue if a bridegroom stands at the junction of cross roads or beside a closed gate on his wedding morn. In England it is thought to be a bad sign if a bride fails to shed tears on the happy day, or if she indulges herself by taking a last look at the looking-glass after her toilet is completed; but she may gratify her vanity without danger if she leaves one hand ungloved. To look back or go back before entering the church-door, to marry in green, or while there is an open grave in the churchyard, are all unfortunate, and the bride must be

careful to go in at one door and out at the other. When the bridesmaids undress the bride they must throw away all the pins. Woe to the bride if a single one be left about her—nothing will go right. Woe to the bridesmaids if they keep one of them, for they will not be married before Whitsuntide, or until the Easter following at the soonest.

If the bridal party venture off dry land, they must go up stream. The bride must, to be lucky, wear

Something old and something new,
Something gold and something blue.

If she should see a strange cat or hear a cat sneeze on her wedding-day, then she will be very happy; and if on her wedding morning she steps from her bed on to something higher, and again on to something higher still, she will from that moment rise in the world.

Gossip.

I am sorry to have occasion to touch once more it shall be for the last time—on the relations between George Eliot and Mr. Lewes. "Gamma" considers that the relationship, "too severely censured by 'Commentator' has been too much defended" by me. I plead guilty to the reverence and love for George Eliot which "Gamma" regards as the cause of my undue defence. But I venture to think that he, though in less degree than "Commentator," is mistaken as to the nature of the relationship he reprehends. From his remarks, one would imagine that George Eliot and Mr. Lewes were somewhat young persons who fell hopelessly in love with each other, and, thus tempted, disobeyed the laws, moral and social, regulating the relations between the sexes. "Gamma" implies also that it was George Eliot, author of "Adam Bede," and therefore one who had set herself up as a teacher, who thus offended. The facts of the case are different. George Eliot was a middle-aged lady, in delicate health, and of narrow means, not as yet the author of any work which had attracted attention, when she made the acquaintance of Mr. Lewes, then well advanced in middle life and a valetudinarian. I need not touch on the unhappy circumstances of Mr. Lewes's married life at that time. Suffice it that his wife, who had gone off with a man of wretched nature, managed so that a legal quibble prevented him from obtaining a divorce in this country, to which he was morally entitled. It was during this season of affliction that George Eliot's sympathies were excited by the unhappy condition of Mr. Lewes's children. On his side there had long been great interest in her literary and philosophical work; and he had recognised the necessity which existed for guidance and sympathy, even though her powers were higher in most respects than his own. That under these circumstances they should decide to seek under the laws of another land the union which a quibble of our divorce laws forbade here, may be regarded, if men will, as injudicious, regrettable, unfortunate, and so forth; but certainly not as guilty or immoral. The passions had nothing to do with the decision; the interests of others besides George Eliot and Mr. Lewes were thoughtfully considered. And so far as the world is concerned, all the best of George Eliot's writings and a large part of the best of Mr. Lewes's later work, would probably have had no existence had their decision been different. This may seem to some a small matter: weighed indeed against a strictly moral obligation it might well be thought so; but George Eliot and Mr. Lewes offended, if at all, against a legal not against a moral obligation,—nay, against only a legal quibble.

I have diligently cancelled every letter or part of a letter bearing on the private life of George Eliot, including some already in type, and several which expressed very just and kindly views. I wish what I have said myself to be regarded simply as expressing my regret that matters with which none of us have the least concern should have been permitted—accidentally, I am well assured—to appear in these columns. Not another line on the subject from me, or from any one else, shall appear here. George Eliot's *philosophy* is another matter; and in so far as it can be dealt with without touching on dogmatic religion may be freely considered.

I find much explanatory work provided for me by the lively "Hallyards," on my return to my own country. I will endeavour to be brief, not "otiose" as he finds me in one of my comments on his views: possibly "otiose" because I agreed with him. Anyway,—"otiose" is good.

I object to "Hallyards" saying simply that I wrote of him years ago that he was "by no means a fool." That would be only less offensive than saying he *was* a fool. What happened was this: "Hallyards," *more suo*, said he feared he had written like a fool, or "to that defect;" and *in reply* I remarked that he did himself injustice.

I must be allowed to maintain that I have never said space must be finite. "Hallyards" thinks I may have said so and forgotten it; because I have said many things and changed my opinion about some. As I only began to write when I was twenty-six years of age, and had very definitely formed my opinion about the question of infinity of space several years before that, nothing but deliberately saying that I thought what I never have thought could have brought about what "Hallyards" has imagined. I *know* I have never done anything of that sort. "Hallyards" does not consider my remark that we cannot conceive infinite space mightily different from what he ascribed to me—the definite statement that space must be finite. I differ from him. What I have constantly said about infinity—using the argument as an apt illustration of our position in regard to the question of Deity—has been this,—

1. Space must be either finite or infinite.
2. We cannot conceive space to be finite.
3. We cannot conceive infinity of space.

∴ 4. Space is a mystery beyond our powers.

I have used a similar illustration in regard to time. And then I have gone on to say, that since we cannot conceive the real nature of either space or time, both being utterly beyond our ken, how infinitely outside the range of our minds must be the nature and attributes of the Power working in and through all things, throughout all time.

It is not for me to explain how "Hallyards" has found in anything thus put the statement that space must be finite.

But it has just occurred to me that supposing "Hallyards" to possess not only a great power of taking things to pieces, but also a wonderful faculty for keeping the pieces apart, he may have recalled in such surprising piecemeal fashion, an account I gave in an article on

Infinity of the argument used first by Aristotle and quoted as "unanswerable but utterly unconvincing" by Sir John Herschel. Said Aristotle, Since whatever two points you take in space the line joining them is finite, space must be finite. I pointed out that the answer to this, which is in effect Euclid's first postulate, is found in the second, Any one of Aristotle's finite lines can be produced to any distance in the same straight line. This necessarily implies infinity; for it is only another way of saying that no line can be regarded as absolutely finite, seeing that every finite line can be extended.

As to stars moving in straight lines, if there were only two stars in the universe, and neither had any motion except on the straight line joining their centres of gravity, those two stars would move on that straight line till they came into collision. Otherwise *not*. The case *is* otherwise.

I may add, without entering into explanations, that—

1. No "clever one" has ever inferred from the probably rectilinear motion of the majority of stars that there may be collisions. "Hallyards" will find the passage he refers to in an article, quoted in Knowledge, by Professor Young. But it will by no means bear his interpretation. Professor Young spoke of stars not moving in closed orbits; but no one knows better than he that they cannot move on the absolutely rectilinear paths imagined by "Hallyards."

2. The earth would under no possible circumstances go off on a straight line, as "Hallyards" imagines.

3. The suspected companion of Venus is *not* supposed to have got loose in this way,—at least by any one knowing aught about the laws of motion.

4. The velocity of the solar system has not been determined at so many miles per second. On certain assumptions as to the distances of the stars of various orders a certain velocity may be calculated as probable. But the assumptions formerly suggested in this way have been negatived in more ways than one.

5. In any case, the sun's path can *not* be supposed to be straight. It is absolutely impossible that it should be.

6. Though (as I have shown) Mädler's idea of a central sun has been disproved, the only positive evidence he advanced having been met by equal evidence pointing in a different direction, the non-existence of a central sun (also not proven) would not leave a single star in the galaxy free to move for ten consecutive seconds in an absolutely straight line.

"Hallyards" remarks that I have changed my mind on more points than one, and "Commentator" ("Hallyards" says) points out that I have flatly contradicted myself about the present habitability of the planets. Unquestionably I have changed my mind on certain subjects after more thorough study of them, or on hearing of fresh evidence. On the peculiarly speculative question of the present habitability of the planets my views are very different now from what they were when I first began to study the subject. But I have never changed my mind without carefully showing that I had done so, and my reasons. That is all a man can do (who wishes to act honestly) after a change of opinion; a man who has never changed an opinion is, of course, a man whose opinion has never been worth anything.

As for the "menacing comet," "Hallyards" appears to suppose I was the author of some article in the *Spectator* criticised—justly as he supposes—in the *Saturday Review*. In reality, I wrote an article in the *Cornhill Magazine* discussing Herr Marth's opinion that the comet of 1880 might return in 1897, and perhaps work mischief. I expressed the opinion that though the comet might seem to menace evil it would work none. This opinion I had defended and emphasised in a later article which appeared some time before the article in the *Spectator*, wherein some one (the editor, I believe) attributed Herr Marth's prediction to me, and showed that he had otherwise misunderstood me.

Before leaving "Hallyards" I may remark, with reference to a subject which the acting editor very properly burked, that Kalekaua, King of the Sandwich Islands, informed me—at a meeting of a little Club of which I was president on board the *City of Sydney* in January, 1881—that but for the rite in question, the native population of the Sandwich Isles would come to an end within—say—ninety years, supposing that to be the greatest time any one now living there would last. This, said that profound and potent monarch, has been proved by abundant experiments, for which missionaries in the Sandwich Isles, who denounced the ancient ways of the islanders, were, in fact, responsible.

Reviews.

SOME BOOKS ON OUR TABLE.

Spectrum Analysis. By the late Dr. H. Schellen. Translated from the third German edition by Jane and Caroline Lassell. Edited, with notes, by Captain W. de W. Abney, R.E., F.R.S. (London: Longmans, Green & Co. 1885.)—The history of spectrum analysis is full of instruction for the student of science. A hundred and thirty-three years ago Melville noted the monochromatic yellow-soda flame, and seventy years later Brewster gave Melville's idea a practical form in his monochromatic lamp. In the same year Sir John Herschel investigated the spectra of various-coloured flames, and some four or five years afterwards we find him saying "the colours thus contributed by different objects to flame afford in many cases a ready and neat way of detecting extremely minute quantities of them." In the year 1826, Fox Talbot, the father of British photography, examined the spectrum of the red fire of the theatres, and showed how its components were rendered perceptible by the various definite bright lines their spectra exhibited, going on to say, "If this opinion should prove correct, and applicable to the other definite rays, a glance at the prismatic spectrum of a flame might show it to contain substances which it would otherwise require a laborious chemical analysis to detect." As an example of prevision this is perfect. Talbot, Brewster, and Herschel alike erred in attributing the most familiar of all spectral lines, the sodium one, D, to water, thinking it incredible that any substance should be so universally diffused as we now know sodium to be. Later on, Talbot showed how strikingly different were the spectra of lithia and strontia—albeit the tint communicated to flame by both of these substances was the same. In 1845, the late Professor W. A. Miller gave maps of the spectra of the metals of the alkaline earths; and Professor Swan, in 1857, at last definitely showed the origin of the D line, and the astonishing delicacy of the Sodium reaction. The discovery of the new metals

Cæsium and Rubidium by Bunsen in 1860, and that of Thallium by Crookes about the same time is a more familiar story, as is that of Indium by Reich and Richter later still. So far we have spoken of the bright lines formed by the glowing vapours of heated substances: it only remains to speak of the spectrum of sunlight, in which we find them under a totally different aspect. At the very beginning of the century, Dr. Wollaston showed that the Spectrum of Sunlight (or rather of an excessively narrow line of it made by passing the Solar rays through a slit) contained some extremely fine hair-like lines, crossing at right angles to its length, and the year before the battle of Waterloo the famous optician Fraunhofer mapped no less than 576 of these lines. How finally Kirchhoff and Bunsen connected these two classes of observation, and hence enabled the terrestrial observer to determine the chemical constitution of the sun and planets, and even of the awfully remote fixed stars and Nebulæ, must be familiar to every one who has ever heard of Spectrum Analysis at all. As a popular account of this most important branch of scientific investigation at once full and accurate, Dr. Schellen's work is unsurpassed. Admirably translated and well edited, its description of the theory and practice of Spectrum Analysis, both celestial and terrestrial, leaves nothing to be desired. The results of the most recent forms of investigation are here given, but by the suppression of what is obsolete in the original edition of the work, Captain Abney has contrived still to keep it within the limits of a single volume. In thus praising the editing of this fine work, however, we should not be doing our duty if we did not invite attention to what we would fain hope is a piece of unintentional unfairness on his part on p. 342, in which, apropos of Janssen's observation of the bright lines of the Solar prominences with an uneclipsed sun, he lets the following words stand in the text without note or comment. "The achievement of Janssen was based upon principles already placed before the scientific world in a paper communicated to the Royal Society by Lockyer, in 1866." Turning to Vol. XV. of the "Proceedings of the Royal Society," p. 258, we find Mr. Lockyer saying, in the October of that year, "May not the spectroscope afford us evidence of the existence of the 'red flames,' which total eclipses have revealed to us in the sun's atmosphere; although they escape all other methods of observation at other times?"—a suggestion of identical value with that of the people who, during the last century, asked: "May not electricity hereafter enable us to communicate at a distance?" as placing "before the scientific world" the principles of the immortal invention of Wheatstone and Cooke. *Litera scripta manet*, and it is undoubtedly to our greatest living English spectroscopist, Dr. William Huggins, and to him alone, that the definite announcement of the method subsequently successfully employed by Janssen is due. On p. 88 of Vol. XXVIII. of the *Monthly Notices* of the Royal Astronomical Society we find:—

During the last two years Mr. Huggins has made numerous observations for the purpose of obtaining a view, if possible, of the red prominences seen during a solar eclipse. The invisibility of these objects at ordinary times is supposed to arise from the illumination of our atmosphere. *If these bodies are gaseous their spectra would consist of bright lines. With a powerful spectroscope the light reflected from our atmosphere near the sun's edge would be greatly reduced in intensity by the dispersion of the prisms, while the bright lines of the prominences, if such be present, would remain, but little diminished in brilliancy.*

In the words which we have italicised in the above quotation the principle on which the spectra of solar prominences are seen in sunshine is stated in the most explicit possible manner. Let the impartial reader judge whether as much can be said for the vague and Zadkiel-like utterance previously extracted from the "Proceedings" of the Royal Society. Having said which, however, we have but little fault indeed to find with a work clearly, pleasantly, and instructively written, splendidly illustrated, and conscientiously edited. The woodcuts of comets and nebulæ might, though, be improved with advantage. A facsimile of one of Mr. Common's astonishing photographs of the great nebula in Orion forms the frontispiece.

Researches on Solar Heat and its Absorption by the Earth's Atmosphere. By S. P. Langley. (Washington: Government Printing Office. 1884.)—At whatever conclusion physicists may arrive with reference to the deductions drawn by Professor Langley from the results of the experiments recorded in the volume before us, but one feeling can be entertained as to the scientific value of the admirable work undertaken by him and carried out with so much zeal and devotion on his own part and that of those associated with him. The expedition whose work forms the subject-matter of his volume was undertaken to determine with the greatest attainable accuracy the amount of heat which the sun sends to the earth, and to this end measures made at the Allegheny Observatory during the years 1880 and 1881 were repeated at different heights on Mount Whitney, in South California, during the latter half of the last-named year. Inasmuch as it was necessary, for the proper conduct of the experiments to be made, that the observers should be situated in very clear air and have at least one-third of the atmosphere below them, the mountain just named was selected as fulfilling both these conditions, its height being between fourteen and fifteen thousand feet, and possessing, further, the special advantages of a dry climate and a very abrupt rise; its precipitous character enabling closely-contiguous stations to be found differing extremely in altitude. The instruments chiefly employed in the investigations were Pouillet's well-known pyrheliometer, the actinometer, and a curious and ingenious piece of apparatus, the invention of Professor Langley himself, which he calls the spectro-bolometer. Into the details of construction of these instruments it would obviously be foreign to the purpose of a review to enter. All we can do here is to give some idea of the results which Professor Langley contends that he has obtained by their aid. He commences by reminding us how it is generally believed that the extreme violet rays are not readily transmissible by our atmosphere, that about one-fifth of the light rays are absorbed and four-fifths transmitted, while the absorption grows greater and greater, the dark heat-rays being almost wholly absorbed. Hence, as is supposed, the heat entering our atmosphere as light, when converted into dark heat escapes with great difficulty, whence the atmosphere acts towards the earth as the glass cover of a hot-bed. This, however, our author declares to be a delusion, inasmuch as the atmosphere acts with a remarkable *selective* absorption; and that in reality the dark heat rays are transmitted the most freely of all, the transmissibility increasing throughout the spectrum as the wave-length increases! One remarkable result of this may just be adverted to. If the blue rays are thus disproportionately cut off, and the remainder of the spectrum in combination affects our eyes as *white* light, it follows that if we could get right outside of the atmosphere the sun would look very blue indeed. Moreover, Mr. Langley finally determines three "calories" as the probable solar-constant. This is another

way of saying that if the earth's absorbing atmosphere were annihilated the sun's rays "would raise one gramme of water three degrees centigrade per minute for each normally-exposed square centimètre of its surface"; which, for the benefit of those happily unfamiliar with South Kensington cram-books, may be translated 15·43 grains of water 5·4 deg. Fahr. per minute for every $\cdot 39371^2$ inch of its exposed surface. If we are to accept Professor Langley's theory of selective absorption and carry it out to its legitimate conclusion, we shall arrive at some pretty startling results. Among them that Sir John Herschel was hopelessly in error as to the lunar temperature ("Outlines of Astronomy," pp. 284-5), which, so far, as he (*loc. cit.*) states, from "*possibly* . . . . exceeding that of boiling water," must—if Professor Langley's views be correct—be considerably lower than −200 deg. Cent., even under a vertical sun! With which astonishing statement we commend the careful perusal of a really remarkable work to every one interested in solar physics and meteorology.

The Asclepiad. By Benjn. Ward Richardson, M.D. July, 1885. (London: Longmans, Green, & Co.)—The observation which we have made above in connection with Mr. Trever's work, that it possesses a certain interest outside of that profession to which it is especially addressed, applies *à fortiori* to Dr. Richardson's capital quarterly magazine, inasmuch as it always contains more or less matter at once readable by and instructive for the ordinary man of science. In the present number an article on "Homeless and Nomadic Populations: their Sanitary Condition and Inspection," quite falls within this category.

Proceedings of the American Philosophical Society, Parts I., II., and III., for 1883. (Philadelphia: McCalla & Stavely.)—The first two parts of these "Proceedings" contain a variety of scientific papers of the type usually found in such publications, but the third possesses a peculiar interest, it being made up of the Old Minutes of the Society from 1743 to 1838. The astronomer will read with interest of the appointment and doings of the Committee to Observe the Transit of Venus in 1769. At the meeting on May 20, it was decided for "Ewing, Williamson, and C. Thomson to wait on Miss Norris, to request the use of her telescope." We wonder who Miss Norris was, and whether her telescope has survived her. Five heliotypes of the exterior and interior of the Society's buildings, and a sixth, which is a facsimile of a letter from Benjamin Franklin, are bound up in the volume.

Geometry and Gravitation. By Alfred Jukes Allen. (London: Abraham Kingdon & Co. 1885.)—All who wish to see the operation of the law of gravitation lucidly explained by geometrical methods should get this little book. The author incidentally shows how it follows from the doctrine of energy that if the velocity of a body describing an orbit about another at a given distance from it is the same in different orbits, the velocity at any other distance is also the same in all. His terminology is of the latest.

The Child's Pictorial. (London: Society for Promoting Christian Knowledge.) *The Little Ones Own.* (London: Dean & Son.)—Full of well-executed coloured pictures, and of tales and sketches adapted to the capacity of our nursery population, each of the publications named above must be eagerly looked for by its juvenile clientèle. The parent who wishes to gratify his tiny ones with a pleasure to be anticipated every month, but who is undecided which of these little magazines to choose, should buy both. They are cheap enough.

THE FACE OF THE SKY.

From August 14 to August 28.

By "F.R.A.S."

The student will turn his telescope on the Sun whenever the sky is clear, to look for spots and faculæ. The face of the night sky is shown in Map VIII. of "The Stars in their Seasons." Minima of Algol will occur at 11h. 38m. p.m. on the 17th, and 8h. 26m. p.m. on the 20th. Mercury is an evening star, but is rapidly getting into an unfavourable position for the observer towards the end of the next fortnight. Venus is an evening star, too, and may be seen glittering over the western horizon after sunset. The rest of the planets are, as we said a fortnight ago on p. 97, invisible. The Moon enters her first quarter at 6h. 14·8m. a.m. on the 16th, and is full at 7h. 54·7m. o'clock in the morning of the 24th. Three occultations of fixed stars occur at convenient hours during the succeeding fourteen days. The first happens on the 20th, when the 6th mag. star B.A.C. 6,287 will disappear at the Moon's dark limb at 11h. 39m. p.m., at an angle from her vertex of 165°, reappearing at her bright limb at 12h. 35m. at a vertical angle of 272°. On the same night, eight minutes after midnight B.A.C. 6,292, another 6th mag. star will disappear at the dark limb at a vertical angle of 115°. It will have set ere it reappears again. Lastly on the 21st ρ^1 Sagittarii, a star of the 4th magnitude, will disappear at the dark limb 35 minutes after midnight, at an angle of 157° from the vertex of the Moon. As in the preceding case, however, its reappearance will be invisible. The Moon is in Virgo all day to day, leaving Virgo for Libra at 12h. 30m. to-morrow night. Forty-eight hours later, *i.e.*, 30 minutes after midnight on the 17th, she passes into the narrow northern strip of Scorpio, from which she emerges at 10h. 30m. the next morning (that of the 18th) and enters Ophiuchus. She leaves Ophiuchus for Sagittarius at 8 a.m. on the 20th. At 11h. 30m. on the night of the 22nd she passes into Capricornus, and from Capricornus into Aquarius at noon on the 23rd. At midnight on the 26th she enters Pisces. She is still travelling through Pisces at midnight on the 28th.

Thunderstorms of a violent character visited various parts of the country last week. At Northampton, on Wednesday, a young man named Soden was struck by lightning, his sight being injured. The West Berks district was visited on Friday by several terrific thunderstorms. The first occurred at about two o'clock in the morning, when the flashes of lightning were frequent and vivid, and the peals of thunder particularly loud. A second storm commenced shortly before midday, but the most serious storm broke over the district in the afternoon, when there was a heavy fall of hail, lasting some time, and doing considerable damage to the corn crops on several farms. A great quantity of rain fell, flooding many places. A heavy thunderstorm prevailed in the district of Aylesbury on Thursday night and Friday, accompanied by torrents of rain. In Hartwell Park, nineteen sheep belonging to Mr. Lee, which had taken refuge under a tree, were struck by lightning. Sixteen were killed on the spot, and the other three were so injured that they had to be slaughtered. A fire-ball, it is said, fell on Hartwell Vicarage lawn during a flash of exceptional vividness and a terrific thunderclap. In other parts of the district injury has been done. Some farm premises at Tring were struck. Birmingham was visited by a heavy thunderstorm, accompanied by drenching showers. The thunderclaps were exceedingly loud, and the lightning flashes very vivid. The storm lasted two hours. During a severe thunderstorm, accompanied by hail, which passed over Melton Mowbray, on Friday afternoon, two houses were struck by lightning. One, the residence of Mr. Robinson, a solicitor, in which three rooms were partially wrecked, and the other the shop of Mr. Smith, a jeweller. One of the most terrific hailstorms ever experienced in Warwickshire visited the Bedworth district on Friday. The hailstones were of enormous size, and the downpour lasted for a long time. Thunderstorms, accompanied by vivid flashes of lightning and torrents of rain, also prevailed in this district at intervals during the day. At Leamington a Mrs. Rouse was struck by the lightning, and rendered blind. On Saturday morning she was in an extremely critical condition, the electric fluid having burnt her severely on the head and face. The crops in the surrounding districts have been considerably damaged by the heavy rain. At Sheffield the storm lasted nearly two hours. It was accompanied by rain and hail, the former falling in torrents. The streets were flooded. Whilst the storm was at its height a main sewer in one of the hilly parts of the town burst with a loud report, tearing up the roadway for a number of yards and flooding houses and shops on both sides of the road. The water in the street was several feet deep. Damage amounting to £1,000 was done. A sewer in another part of the town also burst.

TO CORRESPONDENTS

"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office,* 74, *Great Queen-street,* W.C. If this is not attended to, delays arise for which the Editor is not responsible.

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THE SUBJECTIVE NATURE OF THE OCULAR SPECTRA.

[1861]—The concluding paragraph of my letter (1815) on "The Variation in the Apparent Magnitude of Spectral Images" showed that I was quite prepared for the kind of surprise expressed by your correspondent, Jos. W. Alexander, at the exposition of the science of that subject; or, at least, at the statement that the ocular spectra have no objective existence. Mr. Alexander's letter does not, however, make it quite clear that he is intimately acquainted with the class of phenomena referred to, viz., those sequent sensations to any strong initial excitement of the retina those spectra which have no external objectivity, but which are either persistent sensations or complementary nervous reactions, although the mind of the observer is generally deceived by and attributes externality to them. These sequent sensations have doubtless been termed *spectra* by physicists on account of their absolutely visionary nature. It has already been demonstrated in these pages that colour itself has no external existence whatever as colour; and it might also be demonstrated that even the direct impressions produced by objective realities are but *spectra*—the mere ghosts of things—and that the proximate external causes of the imagery of the optic sense must, in some respects, be very unlike the sensations themselves. Even the causes of some kinds of ocular spectra are only very remotely external. According to Mr. Alexander's own showing, an observer may fancy he actually sees the sun when the sun is below the horizon and has no objective rapport with the eye; the spectrum of the sun in the eye of such an observer is impressed some minutes after that luminary has departed from the apparent position of that spectrum, the immediate cause of which is a telegram of rays, a fasciculus of vibrations, despatched the instant before the sun set. Moreover, any one may convince himself of the troth of the scientific position I am attempting to expound by submitting to be sun-dazed, after which he may turn his back upon the sun and gaze either on a light or on a dark surface, when he will experience a series of ocular spectra of the same magnitude as the original impression, but of different colours; he may also still further satisfy himself that these sequent spectra have no objective externality whatever, that they are merely subjective phenomena, by either closing or bandaging his eyes, for he will even then continue to see them.

My statement (in letter 1815) that the ocular spectra persist of "one constant magnitude" was too absolute, the spectra do change in magnitude as they fade. What I ought rather to have said was that the adaptation of the eye to vision at different distances does not affect their *actual*, but only their *apparent*, magnitude. I will touch upon some other interesting points connected with the phenomena of the ocular spectra in some future communication.

W. Cave Thomas.

COMPOSITE PHOTOGRAPHY AND GENERIC IMAGES.

[1862]—It was stated in a former letter (1,739) that at the Antwerp Art Congress, about the year 1860, I proposed to demonstrate, by the presentation of a number of individual images of the same kind, in rapid succession to the eye, that the resultant generic impression would be more pleasing than any individual instance—to demonstrate by experiment, in fact, that the mean is the measure of the ideal, of the beautiful. To prove this, however, it is not absolutely necessary to have recourse to human forms, the fact can be as well illustrated by the use of geometrical figures; knowing the limits of differentiation of the ellipse, we are enabled to experiment with a series of ellipses, or even with colours, instead of portraits. At the Congress referred to, I proposed to use—nay, did use—similar means to those which have been adopted, time out of mind, for demonstrating, by rapidly rotating a disc before the eyes, that the prismatic colours, being successively excited on the retina, produce a mean impression, or the sensation of white. As the subject of the production of generic images has been again broached in these pages, I beg leave to suggest to experimentalists, to photographers, means for perfecting the process. To this end a zone of portraits should be mechanically constructed to gyrate round the camera, and to pass steadily and evenly before the lens. This would permit of a series of portraits being nicely adjusted prior to their presentation to a sensitised plate. A number of sitters might even be posed and presented in succession to the camera, but to accomplish this successfully the camera itself should be contrived to revolve. The subject of generic images was treated in a paper of mine read some years since, at a Congress of the British Association for the Advancement of Science.

W. Cave Thomas.

INFINITE OR INDEFINITE?

[1863]—May I suggest that a great deal of confusion of thought would be got rid of if, instead of speaking of atoms as *infinitely* small, we were to use the words *indefinitely* or *indeterminately* small. An infinitely small thing has no parts or magnitude—is, in fact, nothing—has no existence. A million times an infinitely small thing is still infinitely small. That we say $\frac{\infty}{\infty} = 1$ merely means that when the numerator and denominator of a fraction are alike its value is 1.

Assume that an atom is to a grain of sand as a cherry is to the earth. Yet a cherry is divisible, and has a peculiar structure. Possibly atoms have in like manner a form and internal structure which may account for their behaviour.

By describing atoms as indefinitely small we merely express our ignorance of their size. An indefinitely small thing that has parts and magnitude is infinitely larger than an infinitely small thing.

E. W. Young.

DARWINISM.

[1864]—It certainly seems to me that Darwin's theory was that, no matter what caused the variation, it was perpetuated by natural selection. He never allowed that it was the nature of a certain species to vary in a certain direction; in fact, that rather was the theory of his opponents. Darwin did not deny that other causes besides natural selection might have produced certain species, but he maintained that natural selection had produced most species, and he endeavoured to show how. I have not his books before me, but, as far as I remember, the conclusion he came to was that man was descended from some marsupial [??] animal through an animal, not unlike our old-world monkeys, which in its turn was descended from a lemur-like animal, and so on back to the marsupial animal which was the progenitor of all placental mammals; and that all existing species were derived from one or two, or certainly very few types. It is some time since I read his works; but, as far as I could understand the question, it seemed to me that the difference between Darwin and his opponents was not the theory of evolution nor of survival of the fittest, but whether the original number of types was very few, or as many, if not more, than at present. Darwin said in effect all the quadrumana are descended from a single pair, all the carnivora from another pair, and so on. He also said all placental animals are descended from a single pair of marsupial animals; all vertebrates from a single pair, and so on. For his arguments, his works must be read. His opponents did not deny evolution, did not dispute the weight of many of his arguments, but they maintained that the original number of types, instead of being fewer were more than at present. It was not maintained that each species was produced ready made, but that, except in the case of very nearly allied species, each species had a separate beginning. Unless it is admitted that life first arose on this globe in some miraculous way, it seems most illogical to suppose that once, and once only, has inorganic matter become an organism. For this is what Darwinism, carried out to its logical conclusion, means. If, as Professor Tyndall explained in his famous Belfast address, organic life is merely the result of the condensation of matter, we are certainly justified in supposing it to have occurred or originated in many parts of the globe's surface, and possibly to be originating in some parts now. There seems also no reason for supposing that

the protoplasm formed should in every case be identical. Until we can trace back the lion and man to a common progenitor we are perfectly justified in coming to the conclusion that each is the result of a separate mass of protoplasm. If we require a common mammal progenitor for all the species of mammals, it seems to me we should require such a length of time for one to develop into a platypus, a whale, and a man, that the palæontological history of the globe would not satisfy the conditions; in fact, it seems to me, *ceteris paribus*, it would take longer for such a mammal to develope into the three species than it would take three masses of protoplasm to do.

What has always struck me as noteworthy is that each division of allied animals develops much the same varieties. Thus we have four-handed animals with long tails, and short tails, with no tails, and with prehensile tails. So we have flesh-eating animals with long tails, with short tails, with no tails, and with bushy tails; gnawing animals with all kinds of tails; ruminants with all sorts of tails, from the tiny tuft of the antelope to the fleshy appendage of the Dumka sheep. Take smaller groups of animals, dogs or cats, it is the same. Tails, we may consider, therefore, are, so to speak, common property. But, on the other hand, teeth seem to vary but little in allied species. Take, for instance, the rodents. The beaver uses its teeth to cut down trees, the squirrel to crack nuts, and the rabbit to eat roots. Which has acquired the teeth by its habits, or what were the habits of the common progenitor? But, if there was a common progenitor, it must have had the distinguishing teeth. Then, again, the carnivora all possess similar dentition, in spite of the different habits of the bear, the lion, the weasel and the hyena. We must imagine the common progenitor to have had similar dentition. If so, a geological period ago the common progenitors of the rodents and the carnivora respectively were as separate types as a rat and a weasel of the present day. Take, again, the position of the mammæ. The progenitor of the ruminants surely had them where every ruminant has them now; the first carnivorous mammal where every carnivorous mammal has them now. The marsupials do not help us, for the kangaroo has them much in the same place where they are situated in man and the higher apes, which position is supposed to have been acquired because man and apes nurse their young in a sitting position. But is it not possible they do so because the mammæ are so situated? A cat must lie down to suckle its young, a cow must stand up, and a monkey more or less support its youngster in its arms. I cannot see how it is possible to conceive an animal so far developed as a marsupial mammal which could, except by inadmissible leaps, vary into the different forms of mammals existent. Is it not more reasonable to suppose that each mass of protoplasm, as it came into existence, began varying in one direction or another according to circumstances? Is there, in fact, such a thing as a cradle of the human race? Is it not possible that when man first assumed humanity he was just as much scattered as the Simiadæ are now. The antiquity of man has been proved to be so much greater than was formerly supposed possible, that the veritable Adam must have existed before the Eocene period; but even then he may have been scattered about and not represented by a single pair. Jos. W. Alexander.

[The reasoning in Mr. Alexander's letter may be to some degree met by the consideration that Darwin nowhere speaks of the single pairs imagined by Mr. Alexander. The whole doctrine of evolution as taught by Darwin is inconsistent with even the bare possibility of a single pair being the progenitors of a new species. Mr. Alexander should go to Darwin's books for Darwin's ideas—as well as for his facts and his arguments.—R. P.].

SURVIVAL.

[1865]—In Feb. last I wrote in *K.* that even a gorilla would laugh at the teaching that man could not have survived without language, association, and weapons. I have not as yet had any overt adhesion to this sentiment on the part of this family; but I have got a long way towards it, in the spontaneous declaration of a Bechuana chief, reported in *Pall Mall Budget*, July 10th, p. 10. "Sechele spoke against the Protectorate. Who wanted it? He did not. It was true they were not strong, and they were surrounded by enemies, but so was the steinboek; *it was weak and small and had many enemies, and yet there were always steinboeks.*"

Pray nail this new trapping on to my hobby. Hallyards.

BIG BIRDS.

[1866]—The other day an eagle was shot in France which measured 1 m. 80 c. from tip to tip of wings—nearly 6 ft. An eagle has a body not so large as a turkey's; I think an average eagle does not sit over a foot high. The ostrich stands 6 ft. high sometimes; the great nuisance of ostrich-farming is that the birds can claw a man down by raising a foot to his shoulders. If the ostrich had wings bearing the same proportion to its body as the eagle's, it is clear that these would be 36 ft. across. If there are condors with bodies as big as the ostrich's, they may, therefore, well (in rare cases) measure 40 ft. from tip to tip.

Hallyards.

THE PHILOSOPHY OF ETHICS.

[1867]—If it is true, it is indeed sad to think that the world is in danger of coming to an end. It is implied in 1828 (*sic*) that morality will be annihilated, involving not only the reversion of the human race to a wild, anti-social state, but their actual extinction afterwards, along with the other mammals and birds—since the duties of parents to their helpless offspring will cease to be recognised.

There is, however, really no fear of a catastrophe, either moral or physical, taking place. "Meter" apparently has not read the papers on morality that appeared in Knowledge about a year ago. Had he done so he would have seen that morality did not necessarily depend on theological notions; in fact, a far higher standard of morality may be deduced from other principles.

In the same letter an extraordinary use is made of Dr. Lewins' doctrine, which throws doubt on the existence of an external world. "Meter" would apparently deduce "orthodoxy" from the premises of the sceptic—the very antipodes of Dr. Lewins' conclusions. The two schools of philosophical sceptics may well be left to adjust their own differences.

It is very true, as Renan says (quoted in 1833), that very few have the right to reject Christianity. (The proposition has also a reverse, which one need not enunciate.) It obviously follows that equally few have a right to determine who belong to the elect number. I do hope "Hallyards" is among the elect, but the curious manner in which he would determine who are sheep and who are goats makes one doubt of him. Why should he exclude all women from participation in the paradise of those who have a right to reject Christianity? Renan's own sister would thus be excluded, to whose memory such a fine tribute is paid in the dedication of the "Vie de Jésus."

The question, stated in general terms, is really, "Who have a right to form their own opinions on religious and philosophical matters." To discuss this fully would require a long letter. We can only say here, that those who use and cultivate their thinking powers have a better right to form their own opinions on religion and philosophy than those who neglect their thinking powers, however much the memories of the latter may be crammed with "learning." It would probably be too much to ask some of the correspondents of Knowledge to study Mill's "Logic;" if, however, they mastered the work, I am persuaded they would considerably modify some of their views. On the other hand, it is only fair to add that Luther had the most thorough contempt for reason. Having exhausted the whole vocabulary of permissible expressions, he had recource to such language that his condemnation of reason cannot now be repeated. Probably, however, if Luther's followers and others had been more reasonable, the Thirty Years' War might have been avoided.

As regards George Eliot, few, I think, have had a better right to form their own opinions on religious matters. She translated Strauss's "Life of Christ" and Feuerbach's "Essence of Christianity," and was thoroughly conversant with all philosophical and scientific questions. T. Common.

THE CHANNEL FEAT.

[1868]—Few things have surprised me so much as the collapse of two of the Oxford crew. I have crossed that water some forty times, and, on the most blazing day, always felt the need of some wrap. Again, I always was somewhat of a weakling; yet when 21, refused insurance for heart-disease, I one evening took a dingy at Oxford, and rowed to Abingdon and back, between six and twelve p.m.; from Nuneham to Oxford I took in a friend, dead weight; no food from twelve to twelve, though beer and claret-cup. The next autumn I "stroked" a fire-engine—five besides myself—without a moment's rest, from ten p.m. to four a.m. The only result was an internal fire, quenched only by a whole quart of Guinness at one draught, in one big glass. I offered to row from Dublin to Ballinasloe in one day—seventy miles by the canal, I think—but found no takers. Galley-slaves used to row often twenty-four hours stark naked. Hallyards.

PHILOSOPHY OF CLOTHING.

[1869]—I am glad to see that Mr. Ollard (1851) has practically discovered the benefit of adopting those principles of clothing which Mr. Mattieu Williams in these columns, and I myself otherwhere,

especially in the *Queen*, have been endeavouring for some time past to explain. The health-value of woollen materials is not sufficiently appreciated, and it is desirable that not only the public who demand clothes, but also those who make it their business to supply them, should be better informed on this point. In this connection I am pleased to be able to say that my own tailor, Mr. T. W. Goodman, of Albemarle-street, W., is as ardent a believer in wool as Mr. Williams and myself, and the excellent tricycle dress for ladies which he has invented is lined throughout with flannel. Besides this, he lines both ladies' and gentlemen's clothes with woollen materials when his customers will consent to this proceeding, to which, however, he informs me many people are opposed, as people always are opposed to anything that is new to them, however good it may be. Ada S. Ballin.

A "CLERICAL ERROR."

[1870]—The Dean of Llandaff, preaching on the *Pall Mall* turned Apostle, spoke of "a mercenary and murderous traffic, in comparison with which the old North-West Passage was but the 'light affliction which is but for a moment.'"

I started, as torpedo-struck.* My father spent four winters without sun, helping to discover the N.W. Passage to India,—reward, £20,000. What could the Dean mean? There never was any "traffic" by that glacial route. Oh! I have it! "The horrors of the Middle Passage"—*i.e.* slaves between Africa and America. A "nice derangement of epitaphs," indeed. Let us hope the tombstones of Llandaff are better ordered. Hallyards.

THE EPITHALAMIUM.

[1871]—Shall I again draw "R. A. P." on my knuckles if I hazard a remark on the latest *poemation* of the Laureate?

Taking a reckless header from off this Third World (easy enough, since an inital velocity of more than twelve miles per second would carry one clear of its attraction—and *thought* goes quicker than that)—Lord T——, like the proud Assyrian of old (Is. xiv. 13, 14), has struck the stars. But either I misapprehend the details of double-star systems, or he does; or, at any rate, he gives a misleading notion of them.

I have always understood that a planet in such a system must have one or other star for a primary. In that case the other would, of course, cause a perturbation in the planet's orbit, but its influence would be insignificant as compared with the primary's (and this is uncomplimentary to *either* the mother or the husband), for the reason that, if not, the primary would cease to be its primary altogether.

"Sway'd by each Love, and swaying to each Love,
Like some conjectured planet in mid heaven
Between two Suns and drawing down from both
The light and genial warmth of double day."

So far as language goes, this would give me the idea either of a planet swinging *to and fro* like a pendulum, never completing a revolution; or revolving round *both* suns, which would be, I suppose, the foci of its ellipse. But, given the distance necessary between two such large bodies, what an improbably large planetary orbit—if possible, even.

Leaving, however, the dynamical question, I think that the Oriental lines on "may your shadow never grow less" would be a rather left-handed compliment if it implied life in a double-star planet. Suppose our sun had a primary large enough to appear, in spite of distance, as large as himself—how could any sort of seed-time and harvest-time go on? If animal life were tolerable when the two suns were in opposition, then it would be impossible when they were not so—a double amount of heat being received. Conversely, if animal life were tolerable with both suns up, then it would be intolerable from cold with only one. On the whole, bad as our poor third world in many respects is, it may be better "to bide wi' the diel ye knaw, than to gane to the deil ye dinna knaw."

"Sway'd by each Love, and swaying to each Love."

I presume that these different participles express the, first, involuntary attraction; the second, voluntary motion towards. If so, the simile is broken, since a planet has no will.

"Mid-heaven" must, I think, mean, not the sky as seen by us, but the region half-way between the two stars; which again indicates the impossible theory—

"Which from her household orbit draws the child
To move in other spheres."

This seems to me imperfect. The expression "to move in a spheres" is neither scientific nor poetical, but rather vulgar. I suppose it hails from the imaginary concentric spheres of the Ptolemaic astronomy. Bodies, however, do not really move in spheres; and I guess that the Laureate never would have thought of it if he had not been astronomically inclined, and so tempted to use an astronomical word, though in quite an improper relation.

In conclusion, I have myself tried the double-star system of matrimony, and am of opinion that a better metaphor would be a shuttlecock between two battledores. Keep up the game long enough, and all three are worn and misshapen.

Lest some one should suppose I am Vandal enough not to like Tennyson, let me add that I think him far above Shakespeare as to form, and not far behind him in substance. I abjure "In Memoriam" as I do the telescope; they both would keep me up at night. If, therefore, I find the last song a little feeble and mawkish, it is surely not from prejudice. Hallyards.

* I have found numbers of people quite ignorant of the real, natural torpedo—now quite eclipsed by the craft, not so happily named, after all—for the eel does not blow his victims into smithereens.

THE RECENT CORRESPONDENCE OF "HALLYARDS."

[1872]—Your correspondent, "Hallyards," in his letters on Evolution puzzled me somewhat until his letter 1767 confirmed my previous suspicion that he had no clear idea of what "Evolution" really teaches. It was satisfactory to find that he wished to investigate the matter, but it is to be regretted that the speculative element in his nature had led him to criticise, and argue the point with, your able writer, Miss Ballin, before having made himself acquainted with the principles of Evolution. He also asks you to publish articles giving all that has been *established* on this subject. I do not think such a short cut would be of any use to him. You can look at established conclusions without understanding them in the least; the important thing is *how* they have been established.

In letter 1763, he says he never could sympathise with the cock-sure. This is amusing in the light of the correspondence with Mr. Proctor, in which he reasserts that Mr. P. did say that which he disclaims; also in letter 1882, in which he states that Miss A. B. Edwards' chronology was *totally impossible*; and again in letter 1833, where he denies that George Eliot was one of the very few having the right to reject Christianity, for the simple reason of her sex. Surely this is dogmatism extraordinary. (Oh! for the power of seeing ourselves as others see us.)

Women admit they do not reason but feel, he says. What has that to do with individual women who do reason, or who are capable of understanding reasons when they are put before them? Moreover, what is there to prevent a woman being convinced by the reasons supplied to her by one of the "Lords of Creation," and afterwards asserting that conviction? In the postscript to letter 1779, "Hallyards" thinks that "St. George Mivart has admitted that special creation of man is not of the essence of Christianity." And clearly if evolution be true, even to the limited extent of man and the different orders of the quadrumana having been evolved from the same primitive stock, there cannot have been a special creation of man. In letter 1816 he says "the standard of morals is always fixed by the laity," and, again, in letter 1833, he harps upon the same string. "The sole standard of conduct for individuals has always been the rule settled by the society of which they form part." And then—he gives a string of illustrations which show what an enormous moral gain it would have been for women to have utterly disregarded their society's standard of morals. These illustrations altogether upset his argument. According to his contention, the wife of Luther must have done a very wrong thing in marrying him, or a Continental officer refusing to fight a duel with another officer must also be doing a wrong thing. I utterly repudiate this absurd doctrine. Some of "Hallyards'" letters are interesting, but I wish he would abstain from Latin quotations, considering that Knowledge is supposed to be plainly worded and exactly described.

Robert Wood.

[1873]—I wish to thank "W." for his (unless one of the other genders be more correct) spontaneous offer to do what I was wishing to do for myself, *i.e.*, index my letters. I meant to suggest to you, sir, that a double correspondence index would be a most useful addition to Knowledge, (1) the correspondents in A B C order; (2) their subjects in ditto. Of all the faults that can be found in a writer, I certainly think the charge of versatility is the most extraordinary. Fancy an editor inscribing over the correspondence columns:—"N.B. No versatiles need apply." "Fear the man of one book," said the schoolmen. "Insist on the man of one book," says "W."

Surely "W." has got the wrong walrus by the ear. At least, if I chanced on so well-bred and well informed a creature, I should chum with him far more gladly than with some others hailing from the same litter.

"W." *might* have quoted two lines which really would have rather hit me on the raw:

"Græculus esuriens, in cœlum, jusseris, ibit
Augur, schœnobates, medicus, magus, omnia novit."

But it is hard in paper war, as in others, to have to put the shot in one's opponent's guns.

I never said that my father, though an "Ancient Mariner," had "shot the albatross"—in this case the condor—nor that *he* had "called the lands after his own name."

Perhaps, after all, my need for index may be obviated by gathering my letters into a volume, "Letters of 'Hallyards,'" the Junius of the twentieth century. "Who was 'Hallyards'?" The Conductor of KNOWLEDGE, and its Editor (himself a veiled prophet) passed hence and made no sign—they alone were in the secret. The only material evidence is a few scraps, bearing French stamps, found in an old waste-paper basket (purchased at its weight in coppers). Why did he sign these? Is it the halyards of a ship? Clearly so—R.N. origin; but then, why not binnacle, or bowsprit, or flying-jib? From internal evidence, one will prove that "H." was Mr. Bradlaugh; another, Cardinal Newman; a third, Lord Shaftesbury; while a fourth will establish beyond all doubt that no one but F. C. Burnand could have written letters containing so many Happy Thoughts. HALLYARDS.

LETTERS RECEIVED AND SHORT ANSWERS.

H. O. DOVE. Last year my own bees and those of all my neighbours produced curiously-dark and discoloured honey. This was universally attributed in my own neighbourhood to the honeydew and concomitant "blight" on the plants frequented by the bees.—J. S. There are no such tables as you ask for, but you may make the calculation for yourself, most simply, thus: Divide the circumference of the earth's orbit in miles by the number of seconds in one revolution, which will, quite obviously, give the length of the arc described in one second. For our purpose we may consider this arc and its chord as coincident. Now, by geometry, twice the radius vector of the earth's orbit : this chord :: chord : distance through which the earth falls towards the sun in a second. See also Chapter II. of "The Sun," by the Conductor of this journal.—J. R. L. Your letter will be handed to "Five of Clubs" the moment he returns to England.—CHAS. J. MABERLY. Wholly needlessly detained through being addressed to the Editor instead of to the *Publishers*.—DR. LEWINS. Received; but you merely reiterate what you have said x times previously.—E. G. S. In reply to you on p. 59, I, in some occult way, entirely forgot the existence of Brande's "Dictionary of Science, Literature, and Art." It is a rather costly work in three volumes, and is published by Longmans.—R. R. ORLEBAR. Had the comet recently discovered by Barnard been fairly observable with any moderate telescope, or possessed the slightest popular interest, I should have at once requested "F.R.A.S." to furnish a descriptive article upon it. When discovered, it was described as "not more than 1′ in diameter; 11th magnitude or fainter (!), and as having some central condensation, but no tail." It is travelling rapidly south, and its theoretical intensity of light is decreasing. At its brightest, it was *imperceptible* in any telescope of less than $2\frac{1}{4}$ inches aperture, and could not be fairly *seen* save in a large one.—SLIM. Any exercise "three minutes' moderate practice" of which is "generally succeeded by bringing up a little blood from the lungs" should be discontinued forthwith. Try the work reviewed on p. 52. You may certainly increase your present very defective chest measurement by properly-regulated exercises, such as was described in the book referred to.—W. H. GREENE. Your extract from "Old Stones" is in no legitimate sense whatever an answer to the theory of Evolution. In fact, it is simply a begging of the entire question. It is certain that for one fossil orm of life that has been preserved unnumbered millions have been destroyed. The hard frame of a crustacean like the trilobite may, under certain circumstances, be preserved; but, considering the conditions of formation of the earlier strata, the marvel is at even traces of that have not all been obliterated. Do you expect to find casts of the soft bodies of Ascidia in metamorphic rocks (!)? With reference to the advertisement of which you speak, see the note beginning p. 72.—W. TAYLOR. There is nothing to prevent you from teaching yourself enough both of chemistry and electricity to furnish you with a perennial source of amusement and delight. If you can afford it, get Roscoe's "Elementary Lessons in Chemistry" and Thompson's "Elementary Lessons in Electricity and Magnetism." They are published at 4s. 6d. each by Macmillan & Co. You need not, however, confine yourself to these two branches of investigation. Obtain and carefully read Tomlinson's "Introduction to the Study of Natural Philosophy," an admirable little eighteenpenny book which forms No. 2 of Weale's "Series," published by Crosby Lockwood & Co.—LUX asks for "the titles of works, &c. (or of the pictures themselves) containing pictures and illustrations teaching moral truths and lessons learned from the study of good and evil as a science." Surely nothing surpasses Hogarth's works for this purpose?—REV. G. HOWARD WRIGHT. Is not the discussion of the Licensing Laws a little foreign to the purpose of a journal devoted to the exposition of popular science?—T. BOLAS AND W. K. BURTON. It would simply waste space to discuss your wholly Utopian scheme here. Any attempt to confiscate property *legally* held (whatever the moral aspect of its original acquirement may have been) in this country could only lead to civil war, in which the army, navy, police, and the overwhelming majority of the Volunteers would be found ranged on the side of law and order. How many weeks is it since a number of Socialists in the great French Republic had the bayonets of the troops in their stomachs in the streets of Paris?—W. M. K. You are apparently under the illusion that you prove a statement by merely *reiterating* it. If everything is to be abolished which "does mischief," the law of gravitation, *inter alia*, will have to go, inasmuch as it is by its operation that the wretched hodman, should he make an unfortunate slip, falls from a five-story scaffold, and is smashed to pieces. It is a gross and scandalous libel upon the millions in this country who habitually take alcohol in strict moderation to say that their temperate consumption of what undoubtedly benefits them "leads to drunkenness." If any habitual drunkard becomes a nuisance to himself and to society generally, by all means legislate for having him locked up like any other lunatic; but don't talk nonsense about the hard-working labourer consuming his well-earned pint of beer. I read Lord Wolseley's speech at the Mansion House, and a very sensible one it was. The same amount of alcohol which is not only harmless, but positively beneficial, in temperate and cold climates becomes hurtful and injurious under a semi-tropical sun; just as a too strictly carnivorous diet does. Spirits, with the thermometer at 98 in the shade, are apt to be injurious. Speaking for myself, I never touch spirits from January to December in any form. Wine, though, and beer—to a small extent—I do take, and, *pace* the hysterical shriekings of the total abstainers, shall continue to take. You say that so-and-so "has been proved over and over again," when all that you really have the slightest right to predicate is that it has been so *asserted*. Your "most of the leading athletes of the world" statement is another example of utterly reckless assertion. I have heard of Edward Payson Weston. Favour me with only six more names. As I may assume as absolutely certain that the opinion of a medical man of such indisputable eminence as Sir James Paget will have more weight with nine hundred and ninety-nine thousandths of rational men than any mere fanatical statements unsupported by proof, I will, in conclusion, quote what he says on the subject: "I would maintain this, and all that can reasonably be deduced from it, namely that the best, and in proportion to numbers, the largest quantity of brain work has been, and still is being, done by the people of those nations in which the use of alcoholic drinks has been and is habitual. Further, I would maintain that, so far as I can judge of the brain work of different persons, they have done best and most who have habitually and temperately taken alcoholic drinks." REV. S. T. B. PEPPIN.—I certainly did only read your letter through once (amid a score or so) but I as certainly imagined that I had mastered the sense of it. I can only regret to find that I have misinterpreted you, and that, for example, what I took for antithesis in your expressed idea concerning shutting our Bible and opening our Darwin was not intended by you as such. No apology is needed for the use of an "elegant expression" employed by Shakespeare, Dryden, Sydney Smith, &c. With reference to your peroration, may I ask you kindly to read, mark, learn, and inwardly digest an article which appeared on p. 475 of Vol. VI. of KNOWLEDGE.—ANONYMOUS (Bristol). I do not know Mr. Edwin Wooton's address, and am hence unable to forward to him (what feels like) the tin canister which you have directed to him at Messrs. Wyman's.—C. D. COLLET. Undoubtedly a tax on locomotion is an evil; but so, in some sense, is every tax. Sad experience of English railways generally (and notably of the Southern lines) might convince anyone that, if the travelling-tax were abolished to-morrow, the *passenger* would derive no benefit from it, as the companies would take exceedingly good care to pocket the money. But the columns of a scientific journal are not the place to discuss this question in.

THERE are now 1,045·5 miles of water mains within the metropolitan area that are under constant pressure.

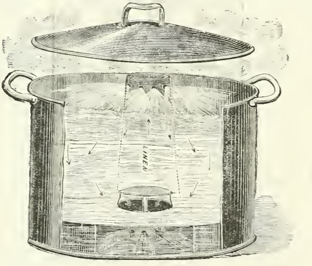
THE Manchester Ship Canal Bill has been read a third time in the House of Commons. The scheme has been before Parliamentary Committees no less than six times.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

WASHING-MACHINE.

This machine, invented by Mr. Harmens, is as simple as it is said to be effective. No rubbing is required, and the use of washing-powders is avoided. It consists of a strong tinned iron case, with copper bottom and extra loose bottom fitting easily in the outer case. When required for use the loose bottom is taken out of the machine, and half a pound of soap, cut into two or more pieces, is put in; the loose bottom is replaced, and, the machine being filled with water to the height of about four inches



on the double bottom, it is placed on the fire. The linen, which is first thoroughly soaked, is wrung and placed in the machine (taking care not to close up any of the holes in the tube), and left for half an hour on the fire. The machine is then removed from the fire, and the contents poured into a tub and well rinsed. If necessary, the machine is again prepared as at first, and again heated for half an hour, and the linen will, it is claimed, be perfectly soft and white, without having received any injury in the washing. The circulation of the water produced in this apparatus is its feature.

LIFEBOAT.

[Patent No. 4,411. 1885.] This boat, invented by Mr. James Wright, of 97, Lucey-street, Bermondsey, S.E., is designed and constructed to right itself with sails set and sheets fast, discharging the whole of the water shipped in 23 or 24 seconds. Her lines are straighter and shear much lower than that of other self-righting boats, making greater speed with head to wind. She has been thoroughly tested at Brighton, Ramsgate, and Margate: and also, previously, in the West India Docks and the Thames, manned with miniature weighted model men, and afforded great satisfaction to those present. The chief novelty of the invention, patented, is the peculiar construction of the fore-and-aft air-tight compartments, without which no boat with "sails set and sheets fast" can right itself.

SASH-FASTENER.

[Patent No. 535. 1885.]—This is a simple, but ingenious, invention by Colonel Henry, of 35, Stanhope-gardens, S.W. The object is to overcome the trouble and inconvenience incident on replacing a broken sash-line (where the ordinary fastening is adopted). Fig. 1 is a perspective view, and Fig. 2 a front view of the fastener. To

Fig. 1.

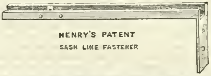


Fig. 2.

fix it, take the sash-frames out in the usual way by removing beading; rip the old sash-line off, taking out all nails. Fit the fastener to the existing slot in frame; the fastener must fit the groove or slot easily, care being taken to keep the fastener in centre of sash bar. Countersink top of sash bar to allow flat top of fastener to go in flush. When accurately fitted put a screw into the slot of frame through the fork of fastener, about midway, and turn the screw down until the head nearly touches the fork. Now take the fastener out and place one end of the new sash-line in lower end of fastener, as shown in Fig. 2, by means of the three screws, which will now hold the rope or line quite firmly, and the fastener can be screwed down to the frame. The sash-frame should now be put back in its proper position, the other end of the rope passed over the pulley, and fastened to weight in the usual way.

When a rope or sash-line breaks where these fasteners are used, it is only necessary to unscrew the top screws, take out fastener, put in a new rope, slip the fastener down the slot again, and screw down to sash-bar.

Our Paradox Column.

"TIME'S UP!"

EDITOR,—DEAR SIR,—How it happens that the "P. D," writings mises your wast paper basket, I cannot tell. If it is simple foreign matter in the Basket,—what kind of matter is paradoxical matter,—if it is so seemingly absurd, and, yet true in fact,—it surely must be the same kind of matter that the great Roman orator failed to express. "It is difficult," he said, "to define Time." St. Augustine, too, confessed his inability; "If no one asks what Time is, I know it; but if you ask me to explain it, I know it not. "and some one else has said, If you do not question me, I understand it," we ought to know something about—that—mysterious principle which operates on every thing, and yet touches nothing. (Time is only a fictitious scale, to show the durability or duration of matter in motion. The same when scientific men speak about the—constitution of Time—weight of matter in motion as a gravitating Body. Therefore the weight of gravity is only the weight of Time.). Time is every thing, and every where. some say; we live in it, and move in it, and within its period we have our being. Without we understand Time, we know—nothing, —to think about the moon been made of green chease,—or the Sun been once or is red hot seems all bush to me.

Yours Truely
Augt 3rd 1885 J. MURRAY.

[Mr. Murray is too modest. He surely does not send "the 'P.D.' writings" to KNOWLEDGE for the purpose of insertion in my "wast paper basket"?—ED.]

A FATAL ERROR.—Two male patients have, says the *Lancet*, been poisoned in St. Louis Hospital, Paris. The pupil in the dispensing department sent poison up to the wards instead of the mixture which was ordered. The dispenser, on becoming acquainted with the deplorable result of his carelessness, attempted to commit suicide, and was only restrained from affecting his purpose by the exercise of considerable violence on the part of the other students.

FROM the Report and Pass-List of the Technological Examinations held by the City and Guilds of London Institute in May last, we gather that no less than 3,968 candidates presented themselves, of whom, however, 2,168 only, or some 55 per cent., succeeded in passing. Some of the examiners speak of a satisfactory improvement in the character of the papers submitted, but there is much more "damning with faint praise" (to say nothing of actual fault-finding) than seems quite desirable.

Our Chess Column.

By Mephisto.

THE SCOTCH GAMBIT.

THE following three examples of the Scotch Gambit are games played last week in the tournament of the Counties Chess Association, at Hereford. Being all played by strong players they will serve as an illustration of the many dangers besetting even the best players in this Opening. We, however, wish our readers to understand that there is a safe way of replying to those particular variations of the Scotch Gambit (the only one which seems to hold out some promise of an attack for the first player is 7. Q to K2). As, however, we have determined only to proceed by way of illustrations from actual play, we shall wait until such a game has actually been played.

ILLUSTRATIVE GAME No. 4.

White. Blackburn.	Black. Gunsberg.	White. Blackburn.	Black. Gunsberg.
1. P to K4	P to K4	7. Q to Q2 (*a*)	Castles (*b*)
2. Kt to KB3	Kt to QB3	8. Kt to Kt5	B × B
3. P to Q4	P × P	9. Q × B	Q to Q4 (*c*)
4. Kt × P	B to B4	10. Kt to Q2 (*d*)	P to QR3 (*e*)
5. P to QB3	Q to B3	11. Kt to B3	Q to R4
6. B to K3	KKt to K2	12. Kt × P, and White won.	

Notes.

(*a*) This move has given a fresh impetus to this Opening. White threatens Kt to Kt5, as the P on B7 is weak.

(*b*) B × Kt leads to an even game. But P to Q4 may also be played.

(*c*) This move is based on a misconception. If White now plays 10. P to KB4, Black has a valid reply in Kt to Q4. But, as may be seen, White has a better move at his disposal.

(*d*) Threatening to attack the Q by Kt to B3.

(*e*) In reply to P to Q4 White would play P to KB4, as the P blocks the square on Q4 for the Kt. In reply to P to B4, White would likewise play 11. P to KB4, for, if Black then plays Kt to Q4, 12. B to B4 follows.

ILLUSTRATIVE GAME No. 5.

First five moves same as before.

White. Schallopp.	Black. Rankin.	White. Schallopp.	Black. Rankin.
6. B to K3	Q to K4 (*a*)	10. Kt × Kt	P × Kt
7. Q to Q3	Kt to B3	11. B × B	P × B
8. Kt to Q2	P to Q3	and White won.	
9. P to KB4	Q to K2		

(*a*) This move cannot be approved, as Black loses important time, which he ought to utilise to develop his pieces, especially as the Q will be driven away from K4 with further disadvantage.

ILLUSTRATIVE GAME No. 6.

First four moves as before.

White. Schallopp.	Black. Gunsberg.	White. Schallopp.	Black. Gunsberg.
5. Kt to Kt3 (*a*)	B to Kt3 (*b*)	12. P to K5 (*g*)	Kt to Kt sq.
6. P to QB4 (*c*)	P to Q3	13. P to KR3 (*h*)	Kt to R3
7. Kt to B3	Kt to B3	14. B to K3	Kt to B4 (*i*)
8. B to K2	Kt to K4 (*d*)	15. B × P	B to K3
9. P to B4 (*e*)	Kt(K4)toKt5	16. B × B	RP × B
10. P to QB5 (*f*)	P × P	17. K to B2	
11. Q × Q (ch)	K × Q	and White won.	

Notes.

(*a*) This form of attack is not new. White undoubtedly gains time, as the B must move now. It is questionable whether it will be of advantage to White later on to have both his Kt's on the Q side.

(*b*) White's intention would be thoroughly defeated if Black quietly retires this B to K2.

(*c*) This is a novelty and creates a weak point in Black's game on account of the threat of P to B5, which must prejudice and embarrass his play.

(*d*) A premature move. Black intended playing P to B3 to make room for his B, not thinking that White could venture on P to B4, which was always threatened, and then P to K5, attacking the QP, with a view to playing P to QB5.

(*e*) The advance of this P is the result of a deep and fine combination.

(*f*) This move gives White a good attack. The possibility of such a move occurring is a weakness which a player ought to avoid if possible, for one can never know how it may suddenly come into operation.

(*g*) The key move of the situation. Black cannot play Kt to Q2, the Kt on Kt5 being then deprived of protection. If he plays Kt to Q sq., the Kt has no move.

(*h*) Still more pressing on Black's game and with a view to playing B to K3, which would not only win back the P but also admit of Castling QR with an attack. The whole idea of giving up the P for the advantage of position belongs to the highest form of Chess.

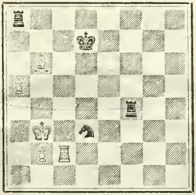
(*i*) The best. P to B5 is not good, on account of 13. B × B, if then P × Kt, 14. B × P (ch), &c.

ENDINGS FROM ACTUAL PLAY.

THE following position occurred in the late tournament at Hamburg. It is most remarkable, as Black lost in spite of being a Rook ahead against two Pawns. Although, of course, the win is only accidental, yet White's play will be found instructive.

Berger.

Black.



White.

Schallopp.

The game continued with—

R to Q2	R to B6	K to Kt7	R to B5
K to B4	R to B sq. (ch)	P to R6	R to Kt5
K to Kt5	R to KB4 (ch)	P to R7	Kt to B4 (ch)
K to R6	R to Q4	K to B sq.	R to R5
R to R2	K to B3	P to Kt4!	Kt to Q2 (*a*)
R to R6 (ch)	R to Q3	B to R5!	R to R7
R × R (ch)	K × R	K to Kt7 and wins.	

(*a*) A very curious draw could be forced by Black if on his 12th move instead of Kt to Q2 Black plays Kt to K3, then 13. B to R5, R × B! 14. P × R, Kt to B2. 15. K to Kt7, Kt to R sq. (best). 16. K × Kt, K to B2. 17. P to R6, K to B sq., stale mate.

WRITING in the *Chemical News*, Mr. P. T. Austen and F. A. Wilber strongly advocate the use of alum for the purification of water, alleging that it not only clarifies but also removes disease germs and ptomaïnes. By adding 2 grains of alum to 60 litres of a rather turbid drinking water, a precipitate settled, and perfectly clear water was obtained after forty-eight hours. The dried precipitate contained per cent. C 16·50, H 2·02, N 0·77, ash 59·28, the latter consisting of small amounts of silica and alumina, large amounts of iron oxide, and considerable quantities of phosphoric acid. The clear water contained the merest trace of aluminium, and a further addition of alum caused no precipitation in it.

Our Whist Column.

By "Five of Clubs."

In the following hand there is only one point of interest; but the whole game is instructive as showing how defensive play should be conducted. It will be observed that *A-B* hold excellent cards, having length in trumps and a long and strong suit:—

The Hands.

B { H. Q, Kn, 5, 4, 3. S. Q, 8, 2. D. 8, 6, 4. C. Q, 7. }

Y { H. K, 2. S. A, 6, 3. D. 10, 9, 7, 2. C. Kn, 10, 9, 5. }

B

Y Z

Tr. H. S.

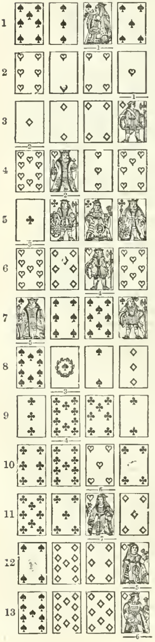
A leads.

Z { A, 8, 7. H. Kn, 5. S. K, Q, Kn, 5, 3. D. K, 4, 2. C. }

A { H. 10, 9, 6. S. K, 10, 9, 7, 4. D. A. C. A, 8, 6, 3. }

Score:—*A-B*, 2; *Y-Z*, 0.

A Y B Z



Notes on the Play.

Card underlined takes the trick and card next below leads next.

1. *A* leads the penultimate, hereafter, I suppose, to be called "the card of uniformity," from his long suit.

2. *B* leads the card of uniformity in trumps. *Z* plays the Ace in order to make sure that a second round is not at once taken out. With a short suit he may be able to get a ruff; and in any case it is the interest of *Y-Z* to check the extraction of trumps.

3. *Z* leads the right card from his long suit; with only one small card the King would have been the correct card.

4. *A* returns the highest of two trumps left. *B* by dropping the Three shows that he had led from five trumps; for the Two has already fallen.

5. *Y* might perhaps preferably have returned his partner's Diamonds; but he has a re-entering card in Spades, and thought it best to see how Clubs lay. Luckily his Clubs are established at once.

7. If *Y* heads the Spade King, *B* must bring in his partner's long suit, unless it so chances that *B* has no Spades. As the score stands *Y* cannot afford to chance this; for if *B* can lead a Spade, *A-B* must make three tricks and the game. On the other hand, even if *B* has not a third Spade, all that will happen will be that *Y*'s Spade Ace will draw a trump from *A*, and it could not be better employed. For *Y* has the command in Clubs, and knows that *Z* has the command in Diamonds. *Y* risks nothing by keeping back the Ace, and ensures his own safety, in what proves to be the actual event.

8. *B*'s command in trumps is nullified; *A*'s long Spades can never now be brought in.

9, 10, 11, 12, 13. However *Y-Z* play, *B* can make only his long trumps. *Y-Z* lose the odd trick only, and the game is saved.

Ace-Lead. — A correspondent calls my attention to another Ace lead which is recognised or rather enjoined in his Club, viz.:—Ace, from Ace, Knave, Ten, Nine. This lead of the Ace is now so thoroughly out of date that I did not think it worth while to consider it. It is contrary to all Whist principles now in vogue, belonging to the old style of play which enjoined the making of all sure tricks in a suit, as a more important point than securing the command of the suit. By leading the nine, the proper lead, either King or Queen is surely brought down, possibly both. If King falls on the left of the leader, he can safely play the Ten on the return of the suit, as Queen does not lie on his left (unless a false card has been played); in any case there is a good chance of making two tricks safely and keeping the command. But if Ace is led originally, and the enemy hold King and Queen, command is lost at once. If the enemy do not hold King and Queen the Nine is obviously the best lead. Very few players in Europe now lead the Ace from Ace, Knave, Ten, Nine; the few that do are found among the last lingering fogies of the old school.

*** Through an oversight, the promise to give the solution to the problem which appeared on page 558 of our last volume has never been fulfilled. The solution, however, will be published in our next issue, together with the names of those who may have solved the problem.

Contents of No. 197.

NOTICES.

Part XLV. (July, 1885), now ready, price 1s. 3d., post-free, 1s. 6d.

Volume VII., comprising the numbers published from Jan. to June, 1885, now ready, price 9s.

Binding Cases for all the Volumes published are to be had, price 2s. each; including parcel postage, 2s. 3d.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, AUGUST 21, 1885.

Contents of No. 199.

FINDING THE WAY AT SEA.

By Richard A. Proctor.

I PROPOSE to give a brief sketch of the methods in use for finding the way at sea, in order that the general principles on which safety depends may be recognised by the general reader.

It is known, of course, to everyone, that a ship's course and rate of sailing are carefully noted throughout her voyage. Every change of her course is taken account of, as well as every change in her rate of advance, whether under sail or steam or both combined. If all this could be quite accurately managed, the position of the ship at any hour could be known, because it would be easy to mark down on a chart the successive stages of her journey, from the moment when she left port. But a variety of circumstances render this impossible.

To begin with, the *exact* course of a ship cannot be known, because there is only the ship's compass to determine her course by, and a ship's compass is not an instrument affording perfectly accurate indications. Let anyone on a sea voyage observe the compass for a short time, being careful not to break the good old rule which forbids speech to the "man at the wheel," and he will presently become aware of the fact that the ship is not kept rigidly to one course even for a short time. The steersman keeps her as near as he can to a particular course, but she is continually deviating, now a little on one side now a little on the other of the intended direction; and even the general accuracy with which that course is followed is a matter of estimation, and depends on the skill of the individual steersman. Looking at the compass card in steady weather, a course may seem very closely followed; perhaps the needle's end may not be a hundredth part of an inch (on the average) from the position it should have. But a hundredth part of an inch on the circumference of the compass card would correspond to a considerable deviation in the course of a run of twenty or thirty knots; and there is nothing to prevent the errors so arising from accumulating in a long journey until a ship might be thirty or forty miles from her estimated place. To this may be added the circumstance that the direction of the needle is different in different parts of the earth. In some places it points to the east of the north, in others to the west. And although the actual "variation of the compass," as this peculiarity is called, is known in a general way for all parts of the earth, yet such knowledge has no claim to actual exactness. There is, also, an important danger, as recent instances have shown, in the possible change of the position of the ship's compass on account of iron in her cargo.

But a far more important cause of error, in determinations merely depending on the log-book, is that arising from uncertainty as to the ship's rate of progress. The log-line gives only a rough idea of the ship's rate at the time when the log is cast;* and, of course, a ship's rate does not remain constant, even when she is under steam alone. Then, again, currents carry the ship along sometimes with considerable rapidity; and the log-line affords no indication of their action: while no reliance can be placed on the estimated rates even of known currents. Thus the distance made on any course may differ considerably from the estimated distance; and when several days' sailing are dealt with, an error of large amount may readily accumulate.

For these and other reasons, a ship's captain places little reliance on what is called "the day's work," that is, the change in the ship's position from noon to noon as estimated from the compass courses entered in the log-book, and the distances supposed to be run on these courses. It is absolutely essential that such estimates should be carefully made, because under unfavourable conditions of weather there may be no other means of guessing at the ship's position. But the only really reliable way of determining a ship's place is by astronomical observations. It is on this account that the almanac published by the Admiralty, in which the position and apparent motions of the celestial bodies are indicated four or five years in advance, is called, *par excellence*, the "Nautical Almanac." The astronomer in his fixed observatory finds this almanac essential to the prosecution of his observations; the student of theoretical astronomy has continual occasion to refer to it; but to the sea-captain the "Nautical Almanac" has a far more important use. The lives of sailors and passengers are dependent upon its accuracy. It is, again, chiefly for the sailor that our great nautical observatories have been erected and that our Astronomer-Royal and his officers are engaged. What other work they may do is subsidiary, and as it were incidental. Their chief work is to time this great clock, our earth, and to trace the motions of those celestial indices which afford our fundamental time-measures, in such a way as to ensure, so far as possible, the safety of our navy, national and mercantile.†

* The log is a flat piece of wood of quadrantal shape, so loaded at the rim as to float with the point (that is, the centre of the quadrant) uppermost. To this a line about three hundred yards long is fastened. The log is thrown overboard and comes almost immediately to rest on the surface of the sea, the line being suffered to run freely out. Marks on the log-line divide it into equal spaces, called *knots*, of known length; and by observing how many of these run out, while the sand in a half-minute hour-glass is running, the ship's rate of motion is inferred. The whole process is necessarily rough, since the line cannot even be tautened.

† This consideration has been altogether lost sight of in certain propositions for extending Government aid to astronomical inquiries of another sort. It may be a most desirable thing that Government should find means for inquiring into the physical condition of sun and moon, planets and comets, stars and all the various orders of star-clusters. But if such matters are to be studied at Government expense, it should be understood that the inquiry is undertaken with the sole purpose of advancing our knowledge of these interesting subjects, and the work should not be brought into comparison

Let us see how this is brought about, not indeed inquiring into the processes by which at the Greenwich Observatory the elements of safety are obtained, but considering the method by which a seaman makes use of those elements.

In the measures heretofore considered, the captain of a ship in reality relies on terrestrial measurements. He reasons that, having been on such and such a day in a given place, and having in the interval sailed so many miles in such and such directions, he must at the moment be in such and such a place. This is called navigation. In the processes next to be considered, which constitute a part of the science of nautical astronomy, the seaman trusts to celestial observations independent of all terrestrial measurements.

The points to be determined by the voyager are his latitude and longitude. The latitude is the distance north or south of the equator, and is measured always from the equator in degrees, the distance from equator to pole being divided into ninety equal parts, each of which is a degree.* The longitude is the distance east or west of Greenwich (in English usage, and now most other nations employ the same starting-point for measuring longitudes from). Longitude is not measured in miles, but in degrees. The way of measuring is not very readily explained without a globe, but may be thus indicated:—Suppose a circle to run completely round the earth, through Greenwich and both the poles; now if this circle be supposed free to turn upon the polar axis, or on the poles as pivots, and the half which crosses Greenwich be carried (the nearest way round) till it crosses some other station, then the arc through which it is carried is called the longitude of the station, and the longitude is easterly or westerly according as this half-circle has to be shifted towards the east or west. A complete half-turn is 180 degrees, and by taking such a half-turn either eastwardly or westwardly, the whole surface of the earth is included. Points which are 180 degrees east of Greenwich are thus also 180 degrees west of Greenwich.

So much is premised in the way of explanation to make the present paper complete; but ten minutes' inspection of an ordinary terrestrial globe will show the true meaning of latitude and longitude more clearly (to those who happen to have forgotten what they learned at school on these points) than any verbal description.

Now it is sufficiently easy for a sea-captain in fine weather to determine his latitude. For places in different latitudes have different celestial scenery, if one may so describe the aspect of the stellar heavens by night and the apparent path of the sun by day. The height of the pole-star above the horizon, for instance, at once indicates the latitude very closely, and would indicate the latitude exactly if the pole-star were exactly at the pole instead of being merely close to it. But the height of any known star when due south also gives the latitude. For at every place in a given latitude, a star rises to a given greatest height when due south; if we travel farther south the star will be higher when due south; if we travel farther north it will be lower; and thus its observed height shows just how far north of the equator any northerly station is; while if the traveller is in the southern hemisphere corresponding observations show how far to the south of the equator he is.

But commonly the seaman trusts to observation of the sun to give him his latitude. The observation is made at noon, when the sun is highest above the horizon. The actual height is determined by means of the instrument called the sextant. This instrument need not be here described; but thus much may be mentioned to explain that process of taking the sun's meridian altitude which no doubt every one has witnessed who has taken a long sea-journey. The sextant is so devised that the observer can see two objects at once, one directly and the other after reflection of its light; and the amount by which he has to move a certain bar carrying the reflecting arrangement, in order to bring the two objects into view in the same direction, shows him the real divergence of lines drawn from his eye to the two objects. To take the sun's altitude then with this instrument, the observer takes the sun as one object and the horizon directly below the sun as the other: he brings them into view together, and then looking at the sextant to see how much he has had to move the swinging arm which carries the reflecting glasses, he learns how high the sun is. This being done at noon, with proper arrangements to ensure that the greatest height then reached by the sun is observed, at once indicates the latitude of the observer. Suppose, for example, he finds the sun to be forty degrees above the horizon, and the "Nautical Almanac" tells him that at the time the sun is ten degrees north of the celestial equator, then he knows that the celestial equator is thirty degrees above the southern horizon. The pole of the heavens is therefore sixty degrees above the northern horizon, and the voyager is in sixty degrees north latitude. Of course, in all ordinary cases the number of degrees is not exact, as I have here for simplicity supposed, and there are some niceties of observation which would have to be taken into account in real work. But the principle of the method is sufficiently indicated by what has been said, and no useful purpose could be served by considering minutiæ.

(To be continued.)

with the utilitarian labours for which our national Observatory was founded.

* Throughout this explanation all minuter details are neglected. In reality, in consequence of the flattening of the earth's globe, the degrees of latitude are not equal, being larger the farther we go from the equator. Moreover, strictly speaking, it is incorrect to speak of distances being divided into degrees, or to say that a degree of latitude or longitude contains so many miles; yet it is so exceedingly inconvenient to employ any other way of speaking in popular description that I trust astronomers or mathematicians who may read this article will forgive the solecism.

THOUGHT AND LANGUAGE.

By Ada S. Ballin.

XV.

OTHER cases of great interest are those in which, although the use of language is not wholly lost, the power of co-ordinating words or syllables is greatly impaired. Patients of this class sometimes pronounce words clearly, but misplace them, so that now and then, if the words are written down, they may be fitted together as in a puzzle, and the patient's idea understood. A case of this kind is mentioned by Winslow.* Dr. Bastian † considers that, "roughly speaking, inability to recall names, or the miscalling of persons, places, or things, would be defects going with injuries to, or altered states of, perceptive centres, and might exist with comparatively slight impairment of intellectual activity; whilst, on the other hand, the extreme forms of amnesia, in which wholly

* "Paralysis from Brain Disease." 1875. p. 189.
† "Brain as an Organ of Mind," pp. 637–8.

irrelevant propositions, or a mere jumble of words are uttered, are more likely to be associated with marked impairment of intellectual power—to be dependent, in short, upon injuries or altered states of parts of the brain more specially concerned with such modes of activity."

Winslow mentions the case of a man who, after an attack of paralysis, transposed the letters of words, saying *tufle* for *flute*, *puc* for *cup*, and *gum* for *mug*. Some letters may always be substituted for others; and the same with syllables. One of Trousseau's cases of aphasia during recovery uttered certain monosyllables to which he always tacked on *tif;* in words of two syllables he pronounced only the first, adding *tif* in the place of the second, as *montif* for *monsieur*, *bontif* for *bonjour*.* Mistakes in the pronunciation and use of words and letters occur occasionally in quite healthy persons, and may or may not be recognised by the speaker. When fatigued or inattentive to what I am saying, I have frequently made slips of the kind, such as asking for salt when I wanted sugar—a request to the absurdity of which I was made alive by a laugh going round the table.

The other morning I was attentively reading the newspaper when my brother made some comment on a daring case of robbery, to which I oracularly replied, "When the cheese is stolen, shut the chamber door!" A remark which, as may be imagined, was greeted with some merriment. In cases like this the fault may be found in lack of attention to the words spoken. Attention implies volition, and when the will is engaged in regulating one set of ideas it is not always immediately at liberty to turn to the consideration of another. Thus during what is called "a brown study," or a fit of abstraction, the thinker may be spoken to, and may not reply for some minutes, then he will answer as if he had only just heard the remark. The attention was retained on the first set of ideas until a natural break came in that train of thought, when it was turned to the other train started by the speaker; on the other hand, a reply may be given at random, as above, without the attention being distracted from the original train of ideas.

The exhaustion of fatigue is proportionately great according as the will is more or less exercised, and this, I think, accounts for the fact that words are misused more frequently during fatigue, for it is impossible to maintain attention beyond a certain point of nervous exhaustion; beyond this point sleep, unconsciousness, or delirium supervenes. Suspension of volition is the essential part of sleep, during which an accumulation of nervous force takes place. Hence, during deep sleep, impressions may be made on the senses without being communicated to the mind—*i.e.*, without being attended to; but when the nervous exhaustion has been repaired, similar impressions will at the same time arouse the attention and the sleeper.

During the suspension of attention in sleep, words may be spoken at random and questions answered with more or less meaning, just as when the attention is otherwise engaged in waking moments.

A similar but more complete suspension of the will takes place during the effects of narcotics or anæsthetics. A typical case of this nature occurred recently in the practice of my friend, Mr. R. Fitzroy Benham. Before the performance of a serious operation an anæsthetic was given to the patient, and while she inhaled it she was told to count ten slowly. She had counted as far as seven when she became unconscious. The operation then began, and lasted for nearly an hour. After this the effects of the anæsthetic began to wear off, and the patient was heard to say, "Eight, nine, ten." She then looked up for further instructions, never suspecting that her counting had for a moment been interrupted. In like manner, volition, and with it attention, may be paralysed by brain injury, and in cases of sudden wounds: for instance, when consciousness is suspended by some portion of the skull pressing on the brain beneath, the train of thought may be broken for weeks or months, but continued immediately on the removal of the pressure on the brain. In cases like this it is probable that impressions are made upon the senses, and are even frequently responded to by the lower nervous centres; but that they take no effect on the higher centres of the brain, owing to the impossibility of attending to them. In a naval battle a sailor was addressed by his superior officer as to the position of a certain vessel. Before he could reply, he was struck in the head by a bullet, and remained insensible for several months, until brought back to England and trephined. Hardly was the operation completed, when the patient uttered these words, "She's to starboard, sir!" in answer to that question put so long ago.

All these and similar cases of suspended attention hang together, the differences between them being only of degree, not of kind. The higher or intellectual centres of the brain being, as it were, paralysed, any action which may take place through the medium of the lower centres is unconscious or automatic.

Other cases apparently originate purely in the loss of memory for words. Such may occur in healthy persons, as people say: "The word is on the tip of my tongue, but I can't get it out."

A case of this kind, brought about by brain disease, is the following, recorded by Dr. Bastian.

Case 8.—The patient became suddenly paralysed in the right side of his body, and speech was almost lost on March 12, 1878, but *sight and hearing were good.* He improved slowly, and his condition on April 2 is thus described:—"He recognises common objects, but cannot name them; repudiates a false name and recognises the real one at once when he hears it. Can never remember his own name till it is suggested to him. On being asked to repeat it (Andrews), after a few trials, which vary each time, he pronounces it 'Anstruthers' or 'Anstrews'; his first name (Thomas) seems to come more readily, and he can often attempt this without prompting. But, either after it has been repeated to him or when he says it spontaneously, he pronounces it 'Towvers.' The letter 'L' is difficult for him to utter; sometimes he pronounces it like a 'D,' and at others like a 'V.' He has been taught to count, *and can fairly pronounce the numerals from one till twelve*; after twelve he is uncertain, the articulation and order becoming rapidly worse. He is conscious when he makes a mistake, but cannot correct himself, and ends in a hopeless muddle. *In reading from a book, the words he pronounces have no relation to the print, either in length or sound. Neither does he seem to understand written characters, as he will not attempt to answer a question written on a slate, though he will at once endeavour to respond when the same question is put to him orally.* He, however, *recognizes numerals from one to nine when written*, and is conscious when they are not placed in regular order. He cannot name any coins, but seems to have some idea of their

* I have met with a somewhat similar case in a little boy six years old, whose speech is defective, but who is, nevertheless, a very bright little fellow. He affixes the syllable *na* (vowel as in Italian) to every word he says, and pronounces only the first syllable of words of more than one syllable. Thus, he says *Edena*, when mentioning the gardener's name, *Ede; Betna*, for his cousin *Bessie;* and *gardna* for *garden*.

relative value. He indicated on his fingers that sixpence was worth six pennies, not being able from sight to utter its name." On May 10 he showed by his gestures that he understood a case in the police news which he was found reading, and could *copy his own name* with his left hand; but did not attempt to write any less familiar word from sound, even when he showed he quite understood it.*

The cases alluded to in this and the preceding article are strongly illustrative of the fact that those physical or mental characteristics which are the latest acquired in the life of the race or the individual, those which have had the least time to become engrained in it, are the first to be lost in the process of degeneration. Thus we find that in cases where the use of language is only impaired, it is always the most familiar words which are retained, the others being lost. It is the same in healthy people as in my own case. When the brain is suffering from exhaustion, recently-acquired facts and words are forgotten until the nervous system has been restored by rest. This, too, seems to explain the fact which is generally remarked on with surprise, that old people who have lost all memory for recent events can distinctly recall even trivial things which happened in their youth. In case 1, the patient used the more familiar word "potatoes" for the less familiar "pills." When urged to write, it was found that he could write his address fairly well, and wrote "My dear sir" correctly, but filled the sheet with meaningless writing, only the word "wife" being legible until his signature, which was as clear as ever, so that he was thus able to write the words which occurred most frequently in his correspondence when in health. Similarly, case 8 could not copy any word but his own name, although he apparently understood others; and as in this case, we find that in cases 6 and 7 the words retained were those most frequently used. We find also that in cases where the use of language is wholly lost, as in cases 2, 3, and 4, a perfect command over gestures is retained. In case 4 we find that the patient, although unable to speak himself, understood speech, and replied in gestures, just as the young child understands words long before it can use them, and just as we find some of the lower animals understanding certain words, a subject to which I shall revert hereafter. At the next stage we find case 2, who could neither speak nor understand language; but who was readily made to understand gestures, and himself used gestures which were strikingly clear. On a still lower level stands case 5, who could only very slightly understand words, but understood gestures at once, although she could not always answer questions by gesture, and her own pantomime was lacking in clearness.

It appears to me that cases of the nature of those to which I have referred afford the very strongest circumstantial evidence in favour of the theory that gesture or imitative language was historically prior to verbal language as we know it, and further evidence in support of this will be forthcoming as we advance in our inquiries.

Speaking at Barnsley on Monday week, Mr. Thomas Burt, M.P., advocated in the case of colliery explosions that they should be the subject of special investigation by experienced men, such as was held when a great railway collision occurred. He impressed upon his hearers, who were mainly miners, the great danger of omitting to support the roof with props and stays. Taking the last thirty years, the number of deaths through insufficient timbering was nearly double the fatalities from explosions. Greater supervision was required in regard to timbering.

* "Brain as an Organ of Mind," pp. 642-3.

FIRST STAR LESSONS.

By Richard A. Proctor.

The constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (α, the *Pole Star*).
2. *Draco*, the *Dragon* (α, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (β, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (α, *Capella*)
7. *Ursa Major*, the *Greater Bear* (α, β, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (α, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (α, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (α, *Vega*).
15. *Cygnus*, the *Swan* (α, *Arided*; β, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (α, *Aldebaran*; η, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (α, *Castor*; β, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (α, *Regulus*).
24. *Virgo*, the *Virgin* (α, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (α, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (α, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (α, *Betelgeux*; β, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (α, *Procyon*).
35. *Hydra*, the *Sea Serpent* (α, *Alphard*).
36. *Crater*, the *Cup* (α, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (α, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (α, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (α, *Sirius*).
45. *Argo*, the *Ship*.

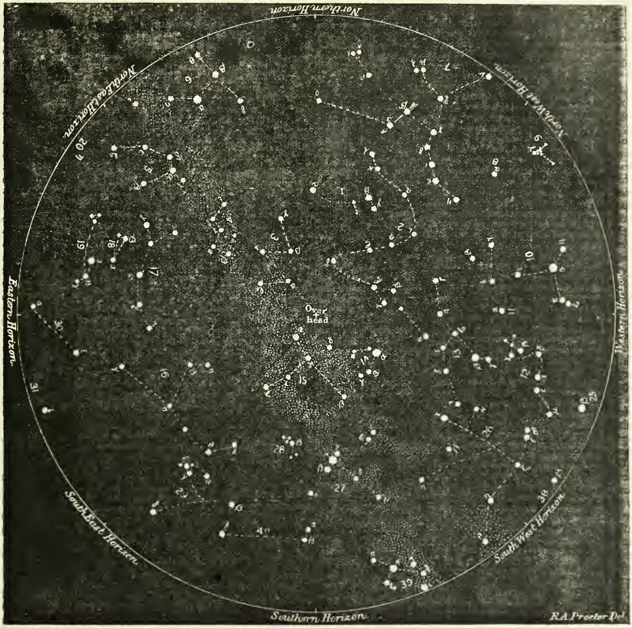
THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

XV.

I SHOULD add, that only a small percentage of the quilts and other clothing material sold as eider-down are really stuffed with the down of the eider-duck. There are many substitutes—some very inferior, others slightly so. The nearest in quality is the down of the King Duck, an Arctic sea-bird of similar habits to the eider-duck. Goose-down is largely used, the best qualities being obtained from Arctic and marine species.

The necessity for an extra supply of air-holding—not oiled—under down in the clothing of such birds is illustrated by a fact not generally known, which came under my notice some years ago in the course of a cruise in a small schooner from Constantinople to London. We took on board an ample supply of live poultry—fowls and ducks. In the neighbourhood of Malta we had very dirty weather, and Jemmy Ducks failed to shelter the animals in his charge from the wash of the sea; the ducks were miserably wetted to the skin in spite of the supposed oiling of their feathers, they all had cramp, and were killed and eaten "to save their lives." The cocks and hens survived, though in the same quarters. This surprised me, but the captain told me that such is usually the case, and I now find that the faithful follower (referred to in my last) is more easily wetted than barn-



NIGHT SKY FOR AUGUST (Second Map of Pair),

Showing the heavens as they appear at the following hours:—

August 23 at 10 o'clock.	September 3 at 9¼ o'clock.	September 15 at 8½ o'clock.
August 26 at 9¾ o'clock.	September 7 at 9 o'clock.	September 19 at 8¼ o'clock.
August 30 at 9½ o'clock.	September 11 at 8¾ o'clock.	September 23 at 8 o'clock.

door fowls if water is projected forcibly upon it, or if rubbed upon the feathers. I attribute this difference to the dusty condition of the clothing of the cocks and hens. Gilbert White, quoting Ray, says (letter 7) "birds of the gallinæ order, as cocks and hens, partridges, and pheasants, &c., are *pulveratrices*—such as dust themselves, using that method of cleansing their feathers and ridding themselves of vermin." My own observations show that some of the dust remains on the surface of the feathers (as may be proved by picking up a fowl and rubbing its breast or other *short* feathers), and that the dust renders these feathers more repellent of projected water-drops. Other surfaces to which, when clean, water adheres are made thus repellent of water-drops by coating them with dust; each particle of dust having its own adherent atmosphere.

Marine birds, especially those exposed to the wash of surf, require a deep and firmly repellent coating of down on their breasts to save them from the fate of our ship ducks. In illustration of the remarkable buoyancy of these, which I attribute to the aërial envelope retained by their abundant down, I may refer my readers to a picture of the red-breasted merganser—an arctic sea-goose—in the current number of *Hardwicke's Science-Gossip*, page 181. The quilled feathers are not immersed at all, only the down of the breast.

I am treating this part of the subject rather more fully than originally intended, as I find that the philosophy of

feather clothing is misunderstood to a greater extent than I anticipated. Thus "G. A.," in KNOWLEDGE, Aug. 7, p. 122, still contends that the oil-glands of the duck are used for oiling the feathers by a painting action of the beak, head, and throat. As already stated, I do not question the structure of the uropigium, as described by "G. A.," and have no objection to calling it an oil-gland. I regard it simply as an exaggerated pair of sebaceous glands resembling in secretion and function, though not in form, the sebaceous follicles described in my last, and the smaller and similar glands at the roots of the wing-feathers. I find the "two little heart-shaped glands," &c., in corresponding position near the root of the tails of cocks and hens, which, as Ray says, are *pulveratrices.* They powder their feathers with dust, which would become dirty adhesive paint if the secretion of the heart-shaped glands were used for oiling them. Besides this, I have examined the bill, head, neck, and back of a duck after it has nibbled and rubbed in the manner described by "G. A.," and positively deny that these parts are then or at any other time smeared with any such fat or oil as stated. The supposed paint-brushes are demonstrably less greasy than human skin, as may be seen by rubbing a clean piece of metal or glass upon the feathers of the head and neck of the duck, and a similar piece in like manner on one's own face and neck, and then comparing the smear. The ducks and swans in our London parks supply further proof. The white species remain white, instead of sharing the colour of London sheep, which they undoubtedly would if their feathers were greasy or oily like the wool, and exposed to the carbon flocculi which shower through our London atmosphere. The brushing action of the head and neck is not always preceded by a pinching of the oil-glands, nor usually so, as anybody may learn by watching the ducks in our parks. They clean their feathers, but do not smear them.

Upon this question of whether the water repulsion depends upon oiling of feathers or upon the adhesion of a film of air to them depends the verdict we must pass upon the desirability of using feathers for bedding and for clothing. At one time I joined with high sanitary authorities in denouncing feather-beds on the ground that, being organic animal matter, they should be liable to organic decomposition, and to saturation with condensed cutaneous exhalations. It is not very long ago since I wrote to my friend Dr. Richardson on the subject; but further investigation now induces me to recant, and the grounds of this recantation are the same as my repudiation of the supposed feather-oiling by ducks.

I find that feather fibres generally (I say "fibres" in order to exclude feather quills) are remarkably free from greasiness or humidity, *more so than any other animal structure* that I am acquainted with. I find also that they are exceptionally free from the vice of condensing sebaceous and other skin exhalations on their surface; that while cotton, linen, woollen, and silken fabrics become defiled by perspiration, feathers, similarly exposed, remain clean. The contents of a flock-bed after a few years of continuous use become matted and foul, while those of a goose-down bed after a similar or much longer period remain untainted; they are only dusty, the dust chiefly due to the fracture of feather filaments. I have examined feathers from a bed that has been half-a-century in continuous use, and find that, after a slight shake, the feathers are as clean as when they were new. Not so the enveloping fabric either inside or out, although it has been washed and renewed frequently during the lifetime of the feathers.

This, if am not altogether mistaken, depends upon the fact that every filament of the down attaches to itself an obstinately-adherent film of air, which prevents the condensation of moisture on its solid surface. Thus we may lie on a feather-bed in a hollow formed by the pressure of our bodies, may perspire freely and moisten the coverings of the feathers, and yet the feathers themselves shall remain dry and untainted, the vapour diffusing itself throughout their adherent atmospheres. The advantage of this is obvious.

Down skirts are made and used, and must be far better than ordinary skirts of similar form, as the required amount of protection is obtained with far less weight. Whenever the merciless despotism of fashion may command its slavish victims to render themselves hideous by exaggerated nether expansions, either behind, or in front, or all round, the unfortunate creatures will suffer less by using light eider-down enlargements rather than metal cages or other heavy substrata. Let me not be misunderstood; I am not recommending such things on their own merits, but only as lesser evils in the meantime, until we can afford to erect lunatic asylums of sufficient capacity to stamp out the fundamental evil.

Feathers have been used as clothing materials by the most primitive of savages, usually by attaching the quill ends of the feathers to each other, and thus building up a mosaic fabric of highly ornamental as well as useful character. That from the South Sea Islands, exhibited by Lady Brassey at South Kensington last year, is a fine example, and said to be of great value. The labour expended on every square yard of such material must be immense; but whether it may be substituted by machinery I am unable to say. Another and a better mode of availing ourselves of the valuable clothing properties of feathers suggests itself, viz., that of carding and weaving the filaments of down, such as common duck and goose down, swans-down, &c. This appears to me to be quite a soluble problem, and I recommend it accordingly to the attention of ingenious mechanicians, believing firmly that such a fabric would, for ordinary clothing purposes, excel all others in lightness, warmth, and durability, with the additional excellence of allowing free passage of the perspiration and being waterproof without any oiling.

Vests and shirts of woven down would, I have no doubt, attain the nearest possible approach to perfection in underclothing for both winter and summer. They may, probably, be difficult to clean. Ordinary scrubbing with soap and water and soda is not likely to succeed. The laundress of the future in dealing with these will have to take lessons from the birds, probably from the *pulveratrices* above-named, and use cleansing powders applied with the aid of suitable brushes—feather brushes, like the duck's head.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

COLEOPTERA (*continued*).

ONE of the finest, though at the same time most destructive, divisions of the beetle order is that called Longicornia, or Longhorns. The beetles are many of them remarkably handsome and of considerable size, and are readily distinguished by the great length of their antennæ, which, in some cases, many times exceed even that of the body itself. These insects, in their larval condition, burrow into the solid wood of timber trees, where they live, often from three to five years, devouring

the heart wood and utterly ruining the timber by excavating through it in various directions neatly-cut galleries, which, commencing on the outside in a small and scarcely noticeable opening, constantly increase in diameter with the growth of the larva.

As a consequence of their longevity and the seclusion of their life, it not unfrequently happens that when an affected tree is cut down and has been sawn up into planks, the latter contain some of the immature larvæ, which escape notice through their burrows not having been sawn through, and thus get conveyed into timber-yards, and even used in building construction, before their occupants have had time to complete the necessary arrangements for making their *début* in beetle society. After awhile, however, this important era in the life of the insects arrives, and the beetles make their exit from their burrows, only, however, to find themselves far away from their native forests, strangers in a strange land, and suddenly introduced into a human society, which is as astonished to receive them as they are to find themselves in its presence. In this way many fine exotic Longicorns have been captured alive in different parts of England, and this, too, is the explanation of the not unfrequent occurrence of the Longicorn beetle called the "Timberman" in mines; they have been introduced, in the larval condition, in the timbers used in roofing and supporting the passages, and have sometimes established themselves and bred there. Various forest trees are liable to the attacks of Longicorn beetles; but, of course, it is those that burrow in firwood that are chiefly imported into this country.

Fig. 1.—Gracilia pygmæa.

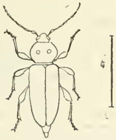


Fig. 2.—Hylotrupes bajulus.

So, then, there are some of these Longicorns that may every now and then be expected to turn-up in houses. Our British species are few in number, and, as a rule, not common; still, I have received one of our smallest in considerable numbers from two different houses. It is a quaint little brown beetle, which is said to be partial to old woodwork, and is called *Gracilia pygmæa* (Fig. 1).

It is a narrow, linear insect, with antennæ only a little longer than the body, the length being produced, as in all this section, not by a multiplication of the joints, but by their individual elongation. It is remarkable for the disproportionate size of the thorax, which, with the head, occupies about one-third the length of the whole body, and for the great breadth of the thighs at their outer extremity. The antennæ, as might be expected, are very liable to damage, and as the insects are pugnacious, if several of them are confined together they are sure to fight, and as a consequence a great mutilation of antennæ and legs ensues, the battle-field being strewn with the fragments.

It has also been found, in large numbers, burrowing in the twigs of a hamper, which, small though they are, afford plenty of scope for our pigmy beetle. Baskets form, in one way or other, an easy means of transference for insects from one country to another. Many continental species are brought over with fruit and vegetables, and the Borough Market, in London, is quite noted for the number of such insects that have been found alive there. About five years ago a French longicorn was introduced in large numbers by means of a basket; some escaped and were afterwards found out in the open, when it seemed as though a new British beetle had been discovered. Fortunately, however, their captor was a coleopterist of repute, and he, by means of careful observation and inquiry, managed to elucidate their history. The account is best given in his own words:—"During the July of 1880, one of my servants brought me two specimens taken in the garden at the back of the house (the only two specimens then noticed). Last July, however (1881), two or three more were captured, and a day or two after they called my attention to the fact that numbers (dozens, in fact) were creeping upon the floor in the scullery: upon examination, I traced them to an old basket used for potatoes, and generally kept under the slopstone, and consequently moderately damp; in this they showed their presence by numerous small round holes, about the size of a pin's head." The basket, on being submitted to a professional basket-maker, was pronounced to be "of French make from Dutch willows." They had, therefore, evidently established themselves in the basket while in their native country, and subsequently accompanied it across the Channel, when it was used for the transport of vegetables.

The larva of a much larger beetle, called *Hylotrupes bajulus* (Fig. 2), has sometimes done considerable damage to the rafters of houses, not only perforating the wood, but even gnawing its way through sheets of lead with which the rafters were covered. Kirby states that Sir Joseph Banks once gave him a specimen of sheet-lead, which, though only measuring eight inches by four, was pierced with twelve oval holes, some of which were as much as ¼-inch in longest diameter. The generic name *Hylotrupes*, which is Greek for a "borer of timber," at once stigmatises the insect as destructive in this way.

The beetle is a blackish insect covered with greyish down, and the name *bajulus*, which is Latin for a "labourer," is apparently given in allusion to the dusty appearance caused by this down. The antennæ are of no more than ordinary length, so that at first sight it would perhaps hardly be taken for a Longicorn at all. The thorax is very globose, and carries two polished knobs on its upper surface. The thighs, like those of *Gracilia*, are clubbed, only more conspicuously so.

The larvæ of these beetles are fat, white, fleshy grubs, with small, but very powerful, black jaws—the tools by which all the damage is effected. The pupa is formed in the burrows.

Fir palings in gardens sometimes produce plentiful supplies of a most lovely beetle, the resplendence of whose appearance is such as to suggest, though falsely, an acquaintance with the glowing rays of a tropical sun, instead of the comparatively feeble beams with which Old England is favoured. It is entirely of a most lovely violet or deep blue colour, and is shaped not unlike *Hylotrupes*, though flatter, and with longer antennæ. In allusion to its colour, it is called *Callidium violaceum*.

Here is a marvel in physiological chemistry! The larva is absolutely white, except for its little black jaws; there is not a trace of blue or any other colour about it, even up to the very time when it ceases feeding and changes into a chrysalis; and yet during its larval existence has been stored up in its body something from which, by the changes that take place during the pupal

stage—a period during which no additional nutriment is taken—is elaborated the gorgeous hue which glorifies its adult form.

Longicorns are frequently very variable in size, as is usually the case with wood-boring insects. Imprisoned as they are in a burrow which, as larvæ, they never leave, they have very little power of selection of food, and are, therefore, entirely dependent upon the supply into the midst of which their excavating labours carry them, and according to the quality of this will be the vigour, or otherwise, of their constitution, and the stature to which they will attain.

(To be continued.)

THE GREAT RED SPOT ON JUPITER.

By Richard A. Proctor.

(Continued from p. 106.)

The spot was manifestly a surface feature, in this sense that the layer of clouds in which the spot appeared as a sort of opening was part of the visible surface of the planet. This was shown by the circumstance that as the spot drew near to and passed the edge of the planet its outline remained distinctly visible. Had the spot been due to some formation lying below the surface clouds of the planet, the spot could not have been thus traced up to the planet's edge. Of course this need not prevent us from recognising the true cause of the spot as existing far below the surface-level; but manifestly the cloud layer was laid open at its outer surface. Now this being so, it is clear that were the forces which formed the spot all at work at that same surface level, and all acting from or towards a centre, we should expect them all to act with about the same degree of force, and the spot to have therefore a circular shape, unless we can recognise some likelihood that in different latitudes on Jupiter different conditions would exist, or in other words unless we can recognise the existence of zones on the planet akin in some sense to the trade and counter-trade wind zones on the earth.

But although the most characteristic feature of Jupiter is the existence, almost always (if not always), of parallel bands or zones of clouds, diverse in their light-reflecting qualities, these zones have no permanent position like the trade zones on the earth. They vary almost capriciously in position. Sometimes there are but four or five of them, at others there are ten or twelve or even more. We cannot recognise any permanent difference, then, in the condition of the various latitudes on Jupiter, to account for the oval figure maintained so long (six years at least) by the great spot.

Yet we may still, or rather we must obviously, associate the lengthening of the great opening in a direction parallel to the cloud zones, with the forces to which the existence of those clouds—as such—is due. Now it has always seemed to me that as the trade wind theory, once complacently advanced to explain the parallel belts of Jupiter and Saturn, most manifestly fails, we are driven to another interpretation of the cloud belts which is very significant in regard to Jupiter's condition. The trade winds and counter trade winds, and the zones named after them, owe their existence to the difference between the rotation velocities in tropical regions which lie farther from the earth's axis and in temperate and arctic regions which lie nearer to that axis. The cloud-belts of Jupiter and Saturn must also be due to differences of rotational velocity,—not however between places in different latitudes on those planets, but between regions at different elevations in the cloud envelopes of Jupiter and Saturn. We seem forced to admit, seeing that the belts are real, and no other way of accounting for their existence seems open to us, that there must be great movements of ascent and descent, in the cloud-laden envelopes surrounding the giant planets. Matter carried upwards, as columns of ascending vapours, or missiles ejected to enormous heights from Jovian volcanoes, passing as such matter does from regions near the centre, where the motion of rotation is slower, to regions higher up, where the motion of rotation is more rapid, lag behind and cause a trailing of cloud forms towards the west. On the contrary, matter descending, as torrents of falling rain, or matter falling back after ejection, would rush forwards and cause the cloud forms to be extended towards the east. Granted a sufficient range in height, whether in ascent or descent, and the parallelism thus arising would be as marked as we actually find it in the cloud-belts of the giant planets.

But here certain questions arise which we must dispose of before we consider in this light the lengthening of the great spot. *Can* we imagine that the cloud-laden envelopes surrounding the giant planets have the enormous depth which this explanation would assign to them? The depth essential for this interpretation must bear a measurable proportion to the diameter of the planet. Less than at least a thousand miles (only a fortieth of the planet's diameter) would certainly not suffice; for obviously the rotational velocities at the top and bottom of a cloud region one thousand miles high on Jupiter would not differ by more than about one-fortieth, or about $2\frac{1}{2}$ per cent., whereas the sharp parallelism of the belts indicates quite a considerable difference of velocities. Taking, however, even a depth of one thousand miles for an atmosphere which at its highest part bears clouds such as exist in our very highest cloud-bearing atmospheric strata, say ten miles above the sea-level, we find a very remarkable state of things at a depth of even but a hundred miles below the visible cloud surface of Jupiter, unless we suppose the laws connecting density and pressure to be very different on Jupiter from the laws recognised here,—a supposition which must not unnecessarily be introduced. For our air ten miles above the sea-level has a density equal to about one-eighth the density of the air we breathe, the density doubling for each $3\frac{1}{2}$ miles (or thereabouts) of descent. Taking this density as that existing at the outskirts of the visible cloud-envelope of Jupiter, we find that with his known (and well-measured) gravitating energy, the density would double for each mile and a half of descent. But say that it doubles only once for two miles of descent. Then four miles below the visible surface of the planet the atmospheric density would be already half (instead of one eighth) of our air's at the sea-level; six miles below it would equal the density of our air; eight miles below it would be double; and only ten miles below the visible surface of Jupiter the density of his air would be four times the density of the air we breathe. After that, in the next ninety miles of descent, taking us only one hundred miles from the surface, there would be forty-five doublings of pressure and density, making the density millions of millions of times greater than that of air, thousands of millions of times greater than that of water, and hundreds of millions of times greater than the density of any terrestrial element. This of course is altogether prepos-

terous. But it shows that in one way or another we have to admit the existence of conditions in Jupiter which are utterly different from any known on earth.

(To be continued.)

THE YOUNG ELECTRICIAN.

By W. Slingo.

(Continued from p. 113.)

Ex. C.—A simply-performed experiment is illustrated in Fig. 55. A B is an electrified rod (of any convenient material, in this case glass). G G are dry warm wine-glasses, E E are eggs placed on the glasses as shown, and touching each other, as at F. On A B being brought near C the eggs become inductively electrified, the near end, C, assuming a state (negative) opposite to that on the adjacent electrified rod. The end D of the other egg becomes simultaneously charged with positive electricity, and were means readily available for investigating the condition of either egg at F, that condition would be found to be neutral. With such investigations we may deal presently. If, while the state of affairs remains as indicated in the diagram, the approach of a suspended feather or pith ball to D will result in attraction. Assuming the suspended substance to have been kept from actual contact with the egg, and to be removed together with A B, the eggs will return to the neutral state, neither D nor C showing any signs of electrification. Nothing has been given to or taken from them.

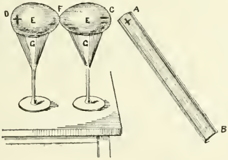


Fig. 55.

Let A B again approach C, the eggs become electrified as before. While A B is still in the vicinity of C, separate the remote or positively-charged egg to a short distance —say half-an-inch—from the other. This can be done with the left hand (catching hold of the glass as low down as possible, and with dry fingers), the right hand still grasping the end, B, of the electrified rod. Next remove A B to a considerable distance. The eggs will now show feeble signs of electrification at C and D, because the opposite charges, in their effort to produce the neutral state, have taken up their position at the adjacent extremities, F. Let the eggs be now separated to a greater distance, so as to be practically out of each other's range of influence. If no other conductor is near the charges on the eggs will be distributed over the surfaces, the greatest accumulation taking place at the ends, because the self-repellant nature of electricity is more nearly satisfied there than at any other (and therefore less distant) parts of the egg. Both eggs will then exhibit more or less powerful charges of electricity, and will be capable of attracting light bodies. After discharging the eggs, let them be again brought into contact and let the positively electrified rod A B again approach C, so as to once more electrify the eggs. Then let D be touched by the finger or any other large conductor; D will be by that means neutralised, and, however great may be the electrification at C, no charge can be maintained at D. The same result would follow were the finger placed at any other part (except that part immediately opposite A) of either of the eggs. In effect, the remote end of the conductor C D is removed to an infinite distance (as indicated in Ex. XCIX.). Let us confine the finger to some portion of the remote egg E D. The removal of A B will allow the negative charge on the other egg to be neutralised. This will not happen if A B be kept near C. Let the finger remain on the remote egg, and let that egg be removed. It will, of course, be neutral; but the subsequent removal of A B will leave the near egg charged with negative electricity, and it will be able to show its charge by any of the previously-mentioned methods.

These two eggs, then, teach us a great deal. Indeed, they may presently teach us a deal more.

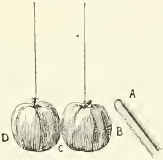


Fig. 56.

Ex. CI.—Fig. 56 illustrates another device for performing all the experiments contained in Ex. C. A is an electrified rod; D C, C B are two apples (with the stalks cut short) suspended by means of dry silk threads from any convenient support, such as a horizontal wooden lath or even a metal rod. The longer the thread, that is, the greater the distance from the horizontal rod, the better. Pared potatoes, turnips, rounded carrots or parsnips, would answer equally well, for all are sufficiently good conductors.

Ex. CII.—A similar experiment, but on a somewhat more elaborate scale, is illustrated in Fig. 57. D and C are cylinders coated with tinfoil or other thin metal, similar in every respect to the one described in Ex. XCVII. S S are the insulating supports, and A B is the

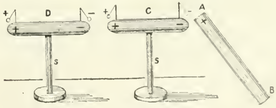


Fig. 57.

rod electrified, let us say, positively. The near end of C becomes negatively electrified, and the remote end positively. We now get a species of induction by deputy. For the positive charge on the distant end of C acts in its turn inductively on the adjacent cylinder D, making the near end negative and the remote end positive. This state of affairs is evidenced by the positions assumed by the suspended but uninsulated pith balls. They mani-

festly share the charges of the parts of the cylinders to which they belong, and equally manifestly, they are therefore repelled by the respective cylinder-ends. The two central balls are not only repelled by the cylinders, but, being oppositely charged, become mutually attractive. If D be touched with the finger, the positive electricity at the distant end will, as in the experiment with the eggs, be neutralised, and the pith ball in proximity will also lose its charge, whence it will fall into the vertical position. Similarly, the finger being withdrawn, and the adjacent ends of the two cylinders brought into contact, will result in a further neutralisation, and the two central balls will also hang vertically. C D will then act as one long cylinder, a greater degree of electrification will probably be produced at the negative end of C, and a positive charge will in consequence appear at the distant end of D equal in quantity to the increase of negative on C. Other experiments with these cylinders may be inferred from the experiments with the eggs.

DUAL GENERATION.

Pr. 5.—The two electric states are always produced together and in equal quantity.

To one conversant with the nature, or rather the behaviour, of electricity, this requires no demonstration. It is well, however, for beginners to have it always in mind. The induction experiments which we have just performed demonstrate the fact pretty clearly, and emphasis was laid upon it in Pr. 1.

Ex. CIII.—Rub a stick of sealing-wax with a piece of flannel or a pad measuring about 5 inches by 4 inches, and composed of five or six layers of flannel sewed together. Let the flannel be insulated from the hand by interposing a piece of sheet gutta-percha (procurable at most of the shops where gutta-percha goods are sold). Either the sealing-wax or the flannel will then be found electrified, although oppositely. That their charge is equal may be proved by presenting both bodies together to a suspended pith ball. The absence of attraction proves the equality; for were one charge greater than the other, that one would exert a preponderating influence and cause attraction.

THE ISLE OF WIGHT STEAM FERRY.*

THE works at Langston Harbour, near Portsmouth, and at Brading, in the Isle of Wight, designed to effect the transport of trains of railway vehicles across the Solent, were completed on the 5th inst., and on the following day the appliances which have more than once been used provisionally during the execution of the works, were pronounced ready for regular traffic. It should be stated that no claim is laid to mechanical novelty—the merit lies in the ingenuity in which commonplace mechanical arrangements have been applied to achieve in a simple way an exceedingly useful purpose. Railways existing on the mainland and in the Isle of Wight, with their lines coming down to the seaside, the problem to be solved was how to transfer simply, cheaply, and expeditiously from the railways to the deck of seagoing vessels, railway vehicles without disturbance of their load. Once upon the deck of the steamer, supposing only she be adapted to the carrying of a heavy deck load, the transport is simple enough—the thing is the loading and unloading, and to be useful this must be accomplished by means more expeditious and less costly than the ordinary method of handling and transhipment. The distance to be traversed between Brading and Langston is between ten and eleven miles, 6½ miles are in the open sea, the rest in land-locked harbours, which, on the island, as on the mainland, have been judiciously chosen as the places of arrival and departure. On both sides the process of loading and unloading goes on in perfectly still water, and on both the mechanical arrangements are the same. The amount of structural work on the island was rather less than that necessary on the mainland, owing to somewhat less favourable conditions at Langston. It goes without saying that on both sides there is direct physical connection with the railway systems. At Brading all the railways in the island are communicated with, while at Langston access is obtained to the Hayling Island branch of the Brighton and South-Coast Railway, which at Havant has a junction with the London and South-Western system—to London by the direct Portsmouth line as well as to Southampton and the West of England.

At Langston the railway skirts the sea. Alongside of, and parallel to, the railway and upon the foreshore an embankment has been built about 700 yards in length, and of width varying from 30 to 40 yards. The side or sea-face of this embankment is sloped and pitched in the customary manner for its entire length, save 300 ft. at the extremity, where a wharf is formed suitable to the use for loading and discharging of ordinary sea-going craft. From the end of the embankment a sloped timber jetty projects, commencing at the rail level and descending by a gradient of 1 in 8 to 4 ft. below the natural bed of the sea. From the top to the bottom of this slope are laid eight ordinary permanent-way rails, four of which constitute two running lines of the standard gauge, and along which, as presently explained, the railway vehicles pass, and four laid close, and parallel, to each of the running rails. These latter act as check rails, but fulfil also a more important purpose to be described.

In carrying the waggons on board the steamer, they are placed upon two lines running from stem to stern. In discharging and loading them, the vessel approaches the sloping jetty stern on, bringing the parallel rails upon her deck into line with the rails laid upon the sloping jetty. It follows that when the tide is high and covers the greater part of the slope, the level of the steamer's deck approaches the level of the top of the jetty; when the tide is low, the steamer approaches at a lower level, and a considerable part of the slope is exposed; but neither at high or low tide can the stern of the steamer be brought sufficiently near to the fixed slope to admit of waggons passing from the one to the other. There is always a hiatus which must be bridged. The four extra rails above mentioned are useful in this connection. They carry the moving bridge or cradle, which, passing up and down the sloping jetty in the varying states of the tide, connect the ship, at whatever height her deck, with the rails on shore.

The cradle, which is supported on twenty wheels, resting five on each of the four rails of the jetty, is of timber with wrought-iron attachments and cast-iron wheels, the movable drawbridge being balanced so as to be well within the power of a single man. It is moved up and down the slope by means of drawing engines, which also drive two horizontal drums 3 ft. in diameter, by means of which waggons are lowered on to and drawn up from the deck of the steamer. The drawing engines are a pair of ordinary winding engines of 60-h.p.

* From *Engineering*.

Attached to the drawing machinery is a movable shunting capstan for economising locomotive power in the station-yard. The steamer is of iron and of great strength, her dimensions being—length, 130 ft.; breadth of beam, 26 ft.; h.p., 150 nominal; draught loaded, 5 ft. 9 in. She has the steam steering-gear of the Harrison type.

The deck arrangement is noteworthy, from the position of the lines of rails. What would in an ordinary railway be the 6 ft. space, is 4 ft. $8\frac{1}{2}$ in. It follows, therefore, that in the event of there not being a sufficient number of waggons to occupy the two outer lines of rails, the load may be placed amidships on the central line, and so contribute to the steadiness and trim of the vessel at sea. The process of loading and discharging may be briefly described. On the approach of the ship, with her cargo aboard, the person ashore in charge of the engines and cradle observes the state of the tide, and, knowing the draught of water, adjusts the cradle by lowering it or raising it to the required level. On the vessel coming into position, the drawbridge, which is raised and depressed by crabs worked from the gantry, is lowered on to the steamer's prow and made fast there. Ropes, which are ready on the drawbridge connected with the winding-gear, are then hooked on to the coupling-chains of the foremost waggons, and on signal being given the whole train is drawn out at one operation. The time occupied in unloading is regulated by the speed at which the engines are run, and this may be fast or slow according to the condition of the tide and other circumstances. At high tide, when the deck of the steamer and the cradle are nearly level with the rails at the top of the slope, the process of discharging may last some thirty or forty seconds. At dead low water, when the slope is at its maximum of steepness, a slower speed is advisable, and the time occupied may vary from two to four minutes. The loading, which is accomplished on a similar principle, requires rather more caution. The waggons, being drawn to the verge of the slope by steam shunting-gear attached to the winding engines, are then allowed to run on to the deck by their own gravity, checked and regulated by the ropes attached to the drums.

When the project was first mooted, doubts were freely expressed as to the sufficiency of traffic to warrant an establishment of this kind. Recently, however, doubts on this subject have been resolved, and it is now anticipated that difficulty is more likely to arise from redundancy than deficiency of freight. The present carrying power, judging from the traffic that is already offering, is likely to require augmentation. Already inland coal traffic is tendered for conveyance fully up to the carrying power, and other branches of traffic to which the system lends itself if presented in the quantity that seems probable, can only be accommodated by an additional vessel. As some indication of the need for improvement which the Transit Company supplies, we quote from an official source a brief description of the plan which the new arrangements supersede. Speaking of goods seeking delivery at the Isle of Wight, the writer remarks:—

> At Portsmouth, where the first handling and delay occurs, everything must be unloaded at the town station and take turn with Portsmouth town goods; then follows cartage through the town to the quay, and two more handlings occur here in unloading the carts and shipping.
>
> Arrived at Ryde the goods are moved again for cartage to the station (through the town of Ryde), and once more there in loading into railway waggons.
>
> At Ventnor, or other destination, the reverse process occurs, and after two more handlings and another cartage, the consignee is at last reached, and it is well if he has nothing to complain of in the condition of his goods.
>
> Since arriving at Portsmouth there have been seven separate handlings, three cartages, a risky water passage, and a railway journey. Although the railway company's responsibility continued throughout, their actual control ceased at Portsmouth, when possession was transferred to the Isle of Wight agents or carriers.

In the future, by contrast, vehicles loaded in London will go direct to their railway destination with no more disturbance to bulk or change of vehicle than is involved in a railway journey between London and Birmingham. The whole of the costly and cumbersome terminal services at Portsmouth and Ryde will be avoided.

The plans and local installations are from the design of Mr. Samuel L. Mason, of Edinburgh, who was also the originator of the scheme. He has closely followed the arrangements of the North British Company at Burntisland, of which he had experience when formerly general manager of that company. The work has been financed and constructed by him, the resident engineer being Mr. William Gregory, C.E. Mr. Stroudley, C.E., of the London, Brighton, and South Coast Railway Locomotive Department, constructed and erected the machinery.

It is in great measure due to the enterprise of the Brighton Board, to their manager, Mr. J. P. Knight, goods manager Mr. Stainforth, and to Mr. Spencer Balfour, M.P., that the Isle of Wight is secured the possession of an economic means of communication of great promise and capability. The Brighton Company have, we are informed, entered into agreements by which they adopt the new route for the whole of their traffic, under conditions which give assurances of financial success.

Reviews.

SOME BOOKS ON OUR TABLE.

The Anatomy of the Intestinal Canal and Peritoneum in Man. By Frederick Treves, F.R.C.S. (London: H. K. Lewis. 1885.)—This is a reprint of the Hunterian Lectures delivered at the Royal College of Surgeons during the month of February of the present year, and constitutes one of the most valuable contributions to our knowledge of intestinal anatomy that has been made for many years. Mr. Treves's exhaustive monograph is founded upon the examination of no less than a hundred fresh bodies, and although, of course, it is primarily addressed to medical men, the lay zoologist and comparative anatomist will find much that is curious in it. The extraordinary variations in length and position of the various divisions of the intestines can hardly fail to strike any one who will glance even cursorily through the volume. To take the small intestine in the adult male as an example. Our author found it to vary between the extremes of 22 ft. 6 in. and 15 ft. 6 in.; while, with reference to position, we learn that the meso-colon may be expected to be found on the left side in 36 per cent. of all cases, and on the right side in 26 per cent. Abdominal surgery has made great strides within a comparatively recent period, but the grave uncertainty introduced by such variations as these must always introduce an element of danger. The work is most handsomely got up in a vellum (or imitation vellum) cover, and is printed on thick antique paper with rough edges.

Faith-healing Tested by Science and by Scripture; a Sermon. By the Rev. J. H. Skewes. (London: Geo. Philip & Son.)—As a rule, we refuse entirely to criticise

sermons; but that by Mr. Skewes shows so conclusively on scientific grounds how utterly baseless is the claim of the "Faith-healers" to any supernatural powers, that we depart from our rule to speak well of it. On his arguments from scripture we are, perforce, silent.

The Handbook of Physiognomy. By Rosa Baughan. (London: George Redway. 1885.)—That certain conformations of features are typical has been abundantly shown by the combined photographs of Mr. Francis Galton, and by these of the recent American observers. Hence any scientific attempt to classify the diverse forms of the various parts of the human face, and to show in what way any peculiar conformation may be expected to correspond with some intellectual peculiarity or gift could scarcely fail to be of value. When however we find Miss Baughan's tract bristling with crazy astrological trash about people being "born under the dominant influence of Saturn"; deriving their temperament from "the influence of Apollo or Mercury"; or exhibiting the "Signature of Jupiter," and the like, we see at once that it is about as valuable from a scientific point of view as Mother Shipton's dream-book, there or thereabouts.

School Hygiene, and Diseases Incidental to School Life. By Robert Farquharson, M.P., M.D. (London: Smith, Elder, & Co. 1885.)—It can scarcely be doubted that in a very large proportion of schools indeed hygiene, if not practically neglected, is made quite ancillary to the one object of loading the pupils up to the very muzzle with as much intellectual pabulum as can by any device be rammed into them. It is, then, alike to teach pedagogues and parents how care for the bodies of growing boys and girls is as essential as are the artifices adopted for training or forcing their minds, that Dr. Farquharson's book is written; and a real and practical work he has produced. He discourses in succession of school buildings, diet, work, and play; gives a capital chapter on the duties of the school doctor; and concludes with a tolerably full account of school diseases. The question of over-pressure in schools meets with incidental discussion, and there are some extremely sensible remarks on school-play. This is a book to be studied by all engaged in the education of children, as well as by those who perforce commit their children to others to be educated.

Key to Euclid's Elements. By John Sturgeon Mackay, M.A., F.R.S.E. (London: W. & R. Chambers. 1885.)—We are a little puzzled by Mr. Mackay's "Key," inasmuch as it contains answers to questions, solutions of problems, and demonstrations of theorems which have no existence in either of the editions of "Euclid" on our own shelves. It quite obviously has reference to some special version of the "elements" of the immortal Alexandrian; but this should have been stated on the title-page. If it be the key to a reproduction of "Euclid" edited by Mr. Mackay himself, which strikes us as being possible, such edition must be a remarkably complete one, inasmuch as a perusal of some of the very numerous answers worked out at length affords convincing proof of the pertinence of the original riders to "Euclid's" own propositions. Possessors of the particular edition of "Euclid" to which Mr. Mackay's "Key" pertains, will doubtless procure it.

Walford's Antiquarian. Edited by Edward Walford, M.A. Aug., 1885. (London: Geo. Redway.)—Full of interest to the archæologist, the historian, the herald, and the bibliographer, Mr. Walford's capital magazine may be commended to all unwilling to sever their connection with the mighty past. The continuation of a very readable article on the Bankside playhouses in Shakespeare's time will be conned with avidity by the modern playgoer who cares to contrast the comparatively rude representations of the Elizabethan Age with the elaborate scenic reproductions of the present day. A "History of Gilds" becomes important at a time when those of the City of London are threatened. Mr. Round puts Professor Freeman on his defence as a historian, while the taste of the more catholic class of readers will be gratified by the perusal of Mr. Johnson's essay on "Thackeray and His Works." We should add that we have only directly referred to four out of the twelve articles which make up the number before us.

Familiar Trees. By G. S. Boulger, F.L.S., F.G.S. With coloured plates by W. H. J. Boot. Part I. (London: Cassells & Co. 1885.)—Mr. Boulger begins his series of "Familiar Trees" with a description of that essentially typical English one, the oak; describing, within the compass of eight pages, the structure, habit of growth, uses, and parasites of the brave old tree, and mentioning certain localities in this country in which it attains great size and perfection. Life-sized coloured drawings of the oak-apple and the acorn, and a chromolithographic reproduction of a spirited water-colour sketch of an oak by Mr. Boot illustrate the text.

The Causes and Prevention of Blindness. By Dr. Ernst Fuchs. Translated by Dr. R. E. Dudgeon, with Notes by Dr. Roth. (London: Baillière, Tindall, & Cox. 1885.)—Of all the afflictions that can fall upon suffering humanity that of blindness is unquestionably one of the most fearful; and it is really terrible to read in the short "Report" prefixed by Dr. Roth to the volume now before us "that *two-thirds* of the 30,000 blind in England, and of the 320,000 in Europe, owe their misfortune merely to ignorance and neglect." Dr. Fuchs' book has its origin in a prize of £80, offered by the London Society for the Prevention of Blindness for the best essay in English, French, Italian, or German "On the Causes of Blindness, and the best Practical Means of Preventing it," and has been published by the Society, which awarded the well-earned prize to its author. The whole subject is treated in a manner at once lucid and attractive; and the perusal of the work will show how widely spread its interest is. A single illustration may be derived from his section treating of myopia, or short-sight, a malady so tremendously on the increase everywhere since the setting in of the educational craze; with reference to which he tells us that "myopia is the cause of 10 per cent. of all cases of blindness of one eye." Surely when concave spectacles and eye-glasses meet one at every turn, there is much to alarm us in a statement like this, given upon such authority. It may further interest a numerous class to learn that immoderate use of tobacco (and also of spirits, though the effect is less marked) causes amblyopia, or partial blindness. Full of the most practical directions for the avoidance and cure of the numerous forms of visual defects described, this is a book which should be studied by every one who values his own sight or that of his children. He that hath eyes to read, let him read it.

We have also on our table *The National Review*, a collection of thoughtful and scholarly essays, *Bradstreet's*, *The Sanitary News*, *The Medical Press and Circular*, *Ciel et Terre*, *The Journal of Botany*, *The Country Brewer's Gazette*, *Electricité*, *The Ilkley Free Press*, *The Tricyclist*, *Wheeling*, the inscrutable scientific journal in Arabic, *The Co-operative Index to Periodicals*, *Our Monthly* (Rangoon), and *Wm. Wesley & Son's Book Circular.*

The number of hands employed in Woolwich Arsenal is 11,200.

CHATS ON GEOMETRICAL MEASUREMENT.

By RICHARD A. PROCTOR.

THE SPHERE.

(*Continued from page* 120.)

A. The demonstration of the volume of the sphere seems as complete as it is simple. Of course by making the triangles $a\,b\,c$, $b\,c\,d$, in Fig. 3, &c. sufficiently small, we make the pyramid C $a\,b\,c$ as nearly equal as we please to the solid sector $C\,a\,b\,c$. In fact, it is obvious that all the portions left over in this way will be included within a spherical shell (between the surfaces of the sphere A B D, and a concentric sphere within it touching the plane of the largest of the triangles $a\,b\,c$, $b\,c\,d$, &c.), and this sphere can be made as thin as we please by making *all* the triangles sufficiently small.

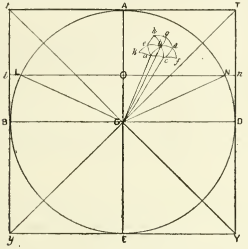


Fig. 3.

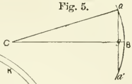
M. That seems to you obvious? I confess I think you are right; for it seems obvious to me also. Yet Euclid made this the theme of the most difficult—at least the longest—of all his problems, viz. the last problem but one of the Twelfth Book.

A. How was this?

M. Because Euclid would not allow of any construction the precise *method* of which had not been determined.

A. Can you indicate an actual demonstration, which shall not be quite so complicated as the "spider's web" proposition to which you refer?

Fig. 5.



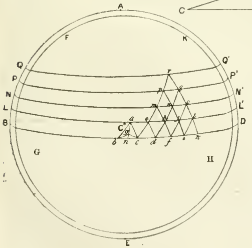


Fig. 4.

Fig.

M. I think so. Let A B E D (Fig. 4) be a sphere, of radius C B (Fig. 5), within which we wish to enclose a polyhedron which shall lie wholly without a concentric sphere F G H K, of radius C g (Fig. 5). Around C as centre (Fig. 5) describe the circular arc a B a', and through g draw $a\,g\,a'$ square to C B. Now let $a\,b\,c$, Fig. 4, be a small plane triangle having sides $a\,b$, $a\,c$ equal, and $b\,c$ *not greater than* either. Suppose $a\,b\,c$ Fig. 6 to represent this triangle, $a\,b\,c$ the circumscribing circle, g its centre, and $a\,g$ Fig. 6 equal to $a\,g$ Fig. 5. Then if gC be drawn in Fig. 6, square to the plane $a\,b\,c$, and equal to Cg Fig. 5, it is obvious (since $a\,g = b\,g = c\,g$, and Cg is square to each) that C a = C b = C c = C a of Fig. 5. Hence a sphere having centre C and radius Ca will pass through a, b, and c; and a sphere having centre C and radius C g will touch the plane $a\,b\,c$ at g (since Cg is square to the plane $a\,b\,c$, and therefore is the shortest distance to that plane). A sphere then F G H K having centre C Fig. 4 and the same radius C g will *not cut* the plane $a\,b\,c$, and will only touch it if $b\,c = a\,b$, or $a\,c$; for if $b\,c$ is less than $a\,b$ the circumscribing circle $a\,b\,c$ Fig. 4 will be less than the circle $a\,b\,c$ Fig. 6, and its plane will therefore be at a distance from C exceeding C g (Figs. 5 and 6). *A fortiori*, any plane triangle with its angular points as a, b, c, on the spherical surface A B D, but having two equal sides each less than $a\,b$, $a\,c$, and the third side not exceeding either, will lie outside the inner sphere F G H K. Now it is easy to divide the whole surface of the sphere into such spherical triangles that the plane triangles having the same angular points will—as thus shown,—not touch the interior sphere. For let the great circle B D be divided into any number of equal parts, $c\,d$, $d\,f$, $f\,i$, $i\,k$, each less than $a\,b$ (which can be done, of course, by continually halving the arcs all round, starting first with quadrants); and let the half quadrant A B be divided into any number of equal parts B L, L N, N P, &c., each less than $a\,n$, the arc through a (Fig. 4) bisecting $b\,c$ in n. Let L L', N N', P P', &c., be parallel small circles through L, N, P, &c., the successive points of division on the quadrant B A. On $c\,d$, $d\,f$, $f\,i$, $i\,k$, &c., as bases, let a series of isosceles spherical triangles $c\,e\,d$, $d\,h\,f$, $f\,j\,i$, $i\,l\,k$, &c., be described, having their vertices e, h, j, l, &c., on L L'; on $e\,h$, $h\,j$, $j\,l$, &c., another series of isosceles triangles $e\,m\,h$, $h\,n\,j$, $j\,o\,l$, &c., having their vertices m, n, o, &c., on N N'; on $m\,n$, $n\,o$, &c., another series of isosceles triangles $m\,p\,n$, $n\,q\,o$, &c., having their vertices p, q, &c., on P Q; and so on continually, until A is reached. It is manifest that the vertices of each circuit of triangles will draw nearer and nearer together, the farther we pass from B D; for the number of them is the same on each successive circle, and the circles continually diminish with increasing distance from B D. Thus the bases of the successive series of triangles grow less and less, as do their equal sides. Moreover the same is true, not only of the triangles as $c\,e\,d$, $d\,h\,f$, $f\,j\,i$, &c., but of the triangles, $e\,d\,h$, $h\,f\,j$, $j\,i\,l$, &c., which are also isosceles, but have their vertices turned downwards instead of upwards. Hence, doing the like with the other half, B E D, of the sphere, we have finally, the surface of the whole sphere divided into a number of isosceles spherical triangles all less than $a\,b\,c$, and none having the centre of its circumscribing circle so near to the centre as g. Hence the series of corresponding plane triangles form a polyhedron enclosed within the sphere A B E D, but wholly without the sphere F G H K.

A. Is that an abridgment of Euclid's proof?

M. No: Euclid's proof is different. He divides the sphere into strips, by a series of great circles all passing through the poles A, E, and each strip into spherical quadrangles by arcs of circles parallel to B D (except at the poles, where, of course, the strips end in spherical triangles). But the demonstration is very complicated, and the result does not seem to me so simple and satisfactory as when the sphere is divided into triangles.

A. You do not think, however, that any demonstration was necessary?

M. No. Take an orange—or, better, a croquet-ball—and mark dots over it so as to form a number of little triangles, beginning with a small equilateral triangle, as $a\,b\,c$ in Fig. 7; and working round it with the points d, e, f, g, h, &c., and you will feel it to be simply obvious that you can cover over the whole surface of the sphere with acute-angled triangles (isosceles if you like, but not all equilateral) as small as you please, and therefore having the planes of the corresponding plane triangles at distances from the centre of the sphere as nearly equal to the sphere's radius as you may please. The matter as little needs proof as the fact that by adding triangles to triangles, all acute-angled, you can cover a plane surface as large as you please.

Fig. 7.

A. Why do you specially mention acute angled triangles?

M. Because the centre of a circle circumscribing an acute angled triangle lies within the triangle, and this makes the study of the problem simpler. But as the diameter of a circle circumscribed around a triangle cannot be greater than the longest side of the

triangle, (and can only be equal to that side when the triangle is right-angled) the limitation is not really necessary.

A. The problem leads of course directly to the determination of the volume of the sphere, from the known area of the sphere's surface.

M. Yes; because the polyhedron enclosed within the outer sphere A B E D, Fig. 4, differs in volume from the sphere itself, by a volume less than that of the spherical shell between the spheres A B E D and F G H K; and this shell may be made as thin as we please by making the radius of the inner sphere as nearly equal as we please to the radius of the outer.

A. Euclid, then, might have determined the solid content of the sphere.

M. Not quite. For he has nowhere shown, nor with his methods is it possible to show, either that the surface of the sphere is equal to the curved surface of the enclosing cylinder, or that the area of an enclosed polyhedron may be made to differ as little as we please from that of the circumscribing sphere. For the last point it would be necessary to show that the area of a plane triangle as $a\,b\,c$ Fig. 4, may be made to differ from the area of the spherical triangle $a\,b\,c$, by a quantity which vanishes in the limit compared with either area, by making the sides of the triangle small enough compared with the radius of the sphere. No one really doubts this; no one for instance, imagines that an equilateral triangle with one-inch sides on a globe as large as our earth differs appreciably from an equilateral plane triangle with one-inch sides. But it is impossible to *prove* this.

A. What do we take next?

M. I think it now may be interesting to determine the areas and volumes of spindles.

A. I should have thought that would require the higher mathematics.

M. No; they can be dealt with geometrically, and by a method applicable to so many problems about curved areas, volumes, &c., that it is well worth studying for its own sake.

(*To be continued.*)

Miscellanea.

Obituary.—Mr. W. J. Thoms, the originator and editor up to 1872 of *Notes and Queries*, died at his residence, St. George's-square, Belgravia, on Saturday last. He was in his eighty-second year.

The necessary arrangements are being made at Chatham Dockyard for lighting the workshops and factories with the electric light, the results of the trial in those of the workshops already lighted by electricity having been found to be satisfactory.

Discovery of Mica.—A recent discovery of mica at Tallulah, Ga., is reckoned the richest in the world. It is said that blocks a foot square can be taken out, and that the supply is declared inexhaustible. There is such a demand for the mineral in stove making that it has been growing scarce and dear for several years.

The Severn Tunnel.—Considerable progress has been made with the works of the Severn Tunnel. The brickwork in the tunnel is practically finished; the western face of the tunnel is built, and the eastern face has been commenced, the ballasting is nearly completed, and the greater part of the permanent way has been laid. About 48,000 cubic yards of excavation still remain to be done in the English cutting, and about 5,000 yards on the Welsh side. Arrangements for the permanent pumping and ventilation are being practically carried out.

The Pacific Mills, situate at Lawrence, Massachusetts, are reported to be the largest textile manufacturing corporation in the world, covering forty-three acres; there are four steam-engines of 3,500 horse-power, forty-two small steam-engines, and fifty boilers and eleven turbines of 5,000 horse-power. The annual consumption of cotton is 15,000 bales; of wool, 4,000,000 lb., the product of 750,000 sheep. The annual capacity is, in cottons, printed and dyed, 65,000,000 yards; worsted goods, 35,000,000 yards, or a total of 100,000,000 yards; 3,600 females and 1,900 males are employed. The roll pay for the year ending May, 1884, amounted to 1,790,000 dols.

A Railway Journey through a Burning Forest.—During the recent hot weather a curious, but somewhat alarming, incident occurred on a railway in Finland. On approaching the town of Kaipios the driver of a train saw that the forest on both sides of the line was burning furiously, enveloping it entirely in smoke and flames. Afraid of proceeding, he despatched a messenger to the town, and after waiting for three-quarters of an hour, during which the fire had extended to both sides of the train, an engine arrived through the burning forest with the message that the line could be safely passed. Doors and windows having been well closed, the train steamed into the burning mass, and succeeded in running the gauntlet safely; but the passengers passed an anxious quarter of an hour, the heat being terrific.

Some interesting statistics in the coal trade have just been published, showing the character of the Welsh trade. The best customer Cardiff has is Port Said, which took 60,000 tons in July, and the least important amongst the principal Buenos Ayres, which took only 12,000 tons. Newport's principal customer is Genoa, which in July took 15,000 tons; Malta only 5,000 tons. Swansea's best customers were the French, Russian, and Genoese ports. During last month Cardiff sent away to foreign destinations, in round numbers, 588,000 tons of coals; Newport, 169,000 tons; and Swansea, 69,000. In the same period Cardiff sent away 13,000 tons of iron and steel; Newport, 7,000 tons of iron and steel; and Swansea, 1,000 tons. Cardiff, 18,000 tons of patent fuel; Swansea, 29,000 tons.

Timber Growth on the Pacific Coast of the United States.—The timber forests of the north-western portion of Washington Territory, U.S., contain a wealth of forest growth which is not met with elsewhere on the globe; 20,000,000 acres of forest growth are environed around the inland waterways of Paget Sound, with a coast line of 1,800 miles, indented with numerous harbours admirably suited to the manufacture of timber into merchant shapes, and loading on vessels. This timber belt, lying between the 47th and 49th parallels of latitude, will average 25,000 feet of lumber to the acre, most of which is fir, but also abounding in cedar, alder, and maple. The value of the twenty-four saw-mills in this district is estimated to be 5,300,000 dols., with a daily capacity of 1,300,000 feet, at which rate it would require 1,000 years to cut up this forest.—*Engineering.*

The Inventions Exhibition.—A supplement to the *London Gazette*, published last week, contains the jury awards—subject to revision—made in the Inventions Division of the International Exhibition at South Kensington. The awards in the Music Division will be published in October. There have been distributed 235 gold medals, 438 silver medals, 515 bronze medals, and 24 diplomas of honour. The following gold medals have been awarded by the Society of Arts on the recommendation of the Juries:—Sir Henry Bessemer, F.R.S., for the invention of Bessemer steel; Percy Gilchrist, for the Thomas-Gilchrist basic process of steel-making; Hathorn, Davey, & Co., for their domestic motor; Samson Fox, for the invention of corrugated iron flues for steam boilers; Crossley Brothers, for the "Otto" gas-engine; Ralph Tweddell, for his system of applying hydraulic power to the working of machine-tools and for the rivetting and other machines which he has invented in connection with that system; Badische Anilin and Soda Fabrik, for their improvements in the manufacture of colouring matters and intermediate products from coal-tar; William Crookes, F.R.S., for his improvements in apparatus for the production of high vacua, and for his invention of the radiometer.

The Government Astronomer of Hong Kong has published a notice with regard to typhoons, from which it appears that the earliest signs of these phenomena in the China seas are clouds of the cirrus type looking like fine hair, feathers, or small white tufts of wool travelling from east to north, a slight rise in the barometer, clear and dry but hot weather, and light winds. These are followed by a falling barometer, while the temperature rises still further. The air becomes oppressive from increasing dampness, and the sky presents a vaporous and threatening appearance. A swell in the sea, and also phosphorescence of the water, as well as glorious sunsets, are other signs useful to the mariner, who is acquainted with the usual conditions in the locality. When the typhoon is approaching, the sky becomes overcast, the temperature in consequence decreases, the dampness increases, and the barometer falls more rapidly, while the wind increases in force. Nearer the centre the wind blows so that no canvas can withstand it, and the rain pours down in torrents, but there is no thunder and lightning. Still nearer the centre there is less wind and rain, and the sky is partly clear, but the sea is tremendous. This is therefore the most dangerous position. Typhoons may be encountered in any season of the year, but are most frequent in August and September. They appear to originate south-east of the Philippine Islands. In August and September they frequently pass east of Formosa, or travel towards north-west up through the Formosa Channel, or strike the coast of China. Afterwards they usually recurve towards north-east and pass over Japan or across the sea north of Japan, but not with the violence that is characteristic of tropical storms. During the remainder of the year they most frequently cross the China Sea from east to west.

Our Inventors' Column.

SHIPS' SIGNAL LAMPS.

[Patent No. 15,147. 1884.]—This invention, by Mr. Edwin Martin, of 68, West India Dock-road, London, E., is intended as a means of ensuring better light and absolute freedom from being extinguished by the violence of the weather, irrespective of its severity. It is, therefore, entitled to greater consideration for the prevention of collisions at sea, which are too frequently caused through the lights becoming extinguished.

It has two lenses, an outer and an inner, either of which may be coloured; between the two lenses there is a space, about $1\frac{1}{2}$ in. wide, for the purpose of admitting a current of air between them, the object being to keep them cool.

The inner lens is fitted inside the body of the lamp, and a shield-plate is so fixed to the lens and sides of the lamp as to prevent any up or down draught coming into contact with the light.

The shield-plate, which is the chief novelty, is fixed to back and sides of the lamp. It is bent conical, and is left open at the top end under the raised top of the lamp.

The outer lens is fitted to a hinged frame, for the more ready convenience of keeping it clean and preventing an accumulation of dirt whereby the full advantage of the light may become unobtainable.

At the bottom of the lamp is a row of air-holes, so constructed as to maintain a clear current of air, and allow it to pass away either top or bottom.

The lamp is proof against being extinguished either by wind or water, without regard to its application.

Colza or petroleum oil may be used for burning, and the method for trimming is similar to that adopted in the ordinary signal lamps now in use.

The body or frame of lamp may be made any size or material.

Trials of Mr. Martin's Lamp have been made with the top open.

1st.—A blast generated by a fan driven by steam power was played on it from every direction; this trial lasted about ten minutes.

2nd.—The lamp was run through a trough of water ten feet long, being held under water.

3rd.—Water from a fire-hose was played on the lamp from all directions for about ten minutes, the top being left open. None of these trials produced any effect.

The lamp had been lit about half-an-hour before the trial took place, so that the metal and glass had plenty of time to heat. It must be admitted that by a very simple and inexpensive contrivance, the patentee has accomplished what he claims for it—viz:—

It cannot be blown out by the wind or put out by water, and is so constructed that the lenses will always keep cool.

These lamps appear to be exceptionally well suited for large or small craft, such as coasters and fishing-vessels that usually carry their lights near the water, as they are not liable to be blown or jerked out by the quick motion of such craft; neither would the lens be damaged or the light affected by sprays or seas going over them.

SLOW FOCUSSING MICROSCOPE ADJUSTMENT.

[Patent No. 12,952. 1884.]—This invention of Messrs. Swift & Sons, of 81, Tottenham-court-road, W., consists of a dovetail slide placed parallel to the optical-tube of the instrument; it is lifted by a trigger-shaped lever, and is depressed by means of a spring from above. The lever is moved by a fine thread-milled head-screw, one turn of which moves the optical-tube a 1,000th part of an inch, thus rendering it sufficiently delicate for all kinds of high-power microscopical investigation, and, by lengthening the lever from its fulcrum, any degree of slow motion can be produced. The dovetail slide and the entire mechanism that moves it is in both directions parallel to the line of motion, thus completely obviating the displacement of the object by tilting—a very common defect in all other fine adjustments where the motive power is not central to the said line. As none of the mechanism enters the optical-tube, this is left quite free for the adaptation of the analysing and binocular prisms, which can be brought much closer to the posterior lens of the objective than is usually the case, thus permitting the use of higher powers than when the fine adjustment is fitted within the microscope tube. One great advantage in this form of fine adjustment over the many others is that the distance between the eyepiece and objective is maintained when this movement is in action. Although it is so exceedingly delicate in use, it will resist the strain of adapting either two or four objectives in their double or quadruple piece.

"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office,* 74, *Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

The Editor is not responsible for the opinions of correspondents.

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

No communications are answered by post, even though stamped and directed envelope be enclosed.

METEORIC DISPLAY.

[1874]—I should be very glad to hear through Knowledge that other readers noticed the meteoric shower that occurred on Monday evening between 9.15 and 10.40. At the same time a brilliant display of lightning illuminated the sky on the eastern horizon.

All the meteors appeared to diverge from a point just below Cassiopeia in the Milky Way. The brightest fell from the zenith in a S.E. direction, about 9.26. When near the horizon it burst, the particles being of a very intense blue colour and formed a tail like a comet's, which was visible for fifteen seconds.

Several others were seen, but none so bright as the one described.

At 10.40 the sky became overcast with clouds.

Bracebridge, Aug. 10, 1885. Jas. Grant.

[The display belonged to the well-known August shower—the Perseids.—R. P.]

METEOR SHOWERS.

[1875]—I should feel much obliged if you would clear up some difficulties in my mind on the subject of meteor showers.

Some years ago I read with the greatest interest a lecture delivered at the Royal Institution, on Feb. 14, 1879, by Mr. G. J. Stoney, F.R.S., on the "Story of the November Meteors." Your articles on meteors in this year's Knowledge considerably discount the value of this otherwise most interesting lecture. To account for these meteors which once travelled together, afterwards lengthening into a procession, he conjectures that the November shower was once (in a.d. 126 probably) a cluster close to Uranus, when the individual meteors, being perturbed in greater or less degree, tended to separate, those most attracted lagging behind. Furthermore, he says at p. 9—"As the comet (with a cluster of meteors within it) swept past the planet, its outlying parts would seem to have grazed his surface, and in this way the gas was probably somewhat more retarded than the meteors; and in the centuries which have since elapsed the meteors have gone so much ahead of the comet that they are now treading on his heels, and on the point of overtaking him, while, probably, the gas has again brought together a smaller cluster of the meteors."

In one of your articles you show clearly that this reasoning is quite fallacious, and that, paradoxical as it might seem, the perturbation would have quite a different effect.

My difficulty is mainly this, that while your argument appears quite correct, Mr. Stoney's would seem to accord better with the evidence.

Here are the points I wish cleared up:—1. Is it not a fact that meteor-trains do lengthen out in the lapse of ages, early in their history being condensed in a compact body like the Leonids of November, and finally straggling so much as to be scattered all round their orbits as the Perseids of August?

2. If they do lengthen out, does it not agree better with Schiaparelli's or Stoney's theory than with yours, which, I take it, assigns to each meteor a new orbit, with major axes lying in different directions, the point of perturbation being the only point common to each orbit?

3. The "gem of the ring" of the Leonids is now a long way from the point of the earth's orbit traversed on Nov. 14.

Would any stray meteors of this shower be seen next November?

If so, how would they get away so far from the main body? (I may mention that last year I watched for them after midnight, but as I saw none in half an hour, I went to bed.)

4. Is the following a valid objection to your theory of a meteor's—or rather a meteor—train, being ejected from planets, sun, or stars? Observation or analogy show that all these bodies rotate. If a shower takes two days or two years to fly past a given point, we must presume (unless a lengthening-out happens in transit) that the shower took two days or two years for the process. But if the process did last so long as this, it would be impossible for all the ejected matter to be expelled from the rotating body in the same direction—unless, indeed, the material was discharged from the poles of the rotating body.

The fixed radiant-point question is very interesting, and I hope a good exposition of the subject will appear in Knowledge.

More Light.

[1. Meteor systems lengthen out. 2. This agrees with my theory at least as well as with Schiaparelli's. 3. The "gem of the ring" of Leonids has passed completely away from the neighbourhood of the earth's orbit. We may, however, be shortly expecting to see some of the meteors scattered in *front* of the main body. 4. If a shower takes two days or two years *now* in passing a given point, it by no means follows that the original cluster took that time in starting—on the contrary we know the present extension of the flight is greater than of old. Hence this peculiarity implies no objection at all to my theory.

Lastly I may remark that my theory was suggested years after I had examined and described the peculiarities "More Light" touches on, besides a number of others which few of those who just now treat of meteors seem to remember—assuming they ever knew them. My essays, written in the years 1866–71, on the November meteors alone would make a good-sized book.—R. P.]

INVISIBLE SUNS.

[1876]—I was much interested by an article by Mr. Proctor which appeared in Knowledge a few months ago, pointing out the comparatively small number of orbs which are likely to be inhabited at any one time. It seems to me that the same chain of reasoning leads to the conclusion that the universe must contain many invisible suns—great orbs like our sun, which have cooled down sufficiently to emit no light of their own.

Some of these may probably be in a condition, as regards temperature, permitting of their habitation by living creatures. It is a curious speculation, What forms of life would be found on such a globe, illuminated, as it would probably be, only by starlight?

Musafir.

SUN WORSHIP.

[1877]—If the writer of the letter No. 1835, page 79, in Knowledge for July 24 of this year will give in Knowledge the source of his information respecting the sun worshippers of Mexico and Peru who "held dogmas almost identical with Christianity," I shall be extremely obliged.

Zeteo.

LIFE IN THE MOON—DEATH OF PLANETS—BLUE SKIES —MOISTURE OF THE ATMOSPHERE—SOLID OXYGEN— THE WATERS ABOVE THE FIRMAMENT.

[1878]—By referring again to letter 1812, "Hallyards" will find that the remarks contained therein, concerning imaginary men in the moon, are just as applicable to his new example of Uley Bury as they were to the case of the Pyramids, which he has seen fit to lay aside.

Unless "Hallyards" can demonstrate the probability he assumes, the age of life in the moon must have overlapped a period, the exact counterpart of a given period of life on the earth, and yet not have exceeded the present; he may throw back the age of man and his work as many centuries as he pleases without affecting the question in the least.

In the absence of an occasional fact or even probability to guide, it is penetrating far enough into realms of imagination, to picture either an inhabited moon, or a moon never the abode of life, without defining a limit to the civilisation or brain power of the merely-conjectured Lunarians. Furthermore, the wish to compare specimens of human work, lunar and terrestrial, without a comparison of the circumstances giving rise to the work in either case, shows a decided tendency to build "castles in the air."

I must inform "Hallyards" that I do not "contend" for the "man in the moon," my *contention* is simply that there may have been men in the moon for all he has said to disprove it. There are perhaps more weighty reasons against an inhabited moon than those advanced by "Hallyards." (By-the-way, I should like to hear a few particulars of "Uley Bury" and H.'s authority for its remote age.)

"There is nothing to show that planets die, so long as they have their sun." Which *is* (or rather *was*) the sun of the moon, the earth, or our sun? The earth, I should think; and since the moon's sun has cooled down sufficient to bear life, the *death* of its planet can be easily understood. What will the earth be like when *our* sun is cool enough to bear life?

The "positive fact" that northern skies are bluer than those of the "sunny south" needs some slight corroboration.

Walking through a picture-gallery a day or two ago, I could not help noticing how different tints of blue (independent of cloud colour) were characteristic of different latitudes. We are all prone to mistakes ("H." not excepted); but seldom is the fact so exemplified, as in the case of our artists in their endeavour to reproduce nature, if "Hallyards" in this instance be correct.

Once again, "Hallyards" has supplied me with the argument against himself. A better proof that the amount of aqueous vapour must be greater in warm climates than in cold, I could not have wished than that instanced by the sudden introduction of "French rolls" into this discussion. Because in France, "rolls" and things in general are unusually dry, he concludes that the atmosphere likewise is dry. Will "Hallyards" explain where the moisture of the rolls, &c., has gone? It has simply evaporated, which means, the solvent power of air being raised by an increase of temperature, the water required to saturate it is drawn from wherever water is exposed, be it lake, river, rill, or "roll."

I am asked to "demonstrate that (the atmosphere of) the parched Soudan has more water than the storm-swept Arcades." If the foregoing example is not sufficient, the following figures will explain:—

Air absorbs one hundred and sixtieth part of its weight in aqueous vapour at 32°, one-eightieth at 59°, one-fortieth at 86°, summer heat, and a twentieth at 113°, intense heat.

As to solidified oxygen and nitrogen, like the discovery of the conjectural metal hydrogenium, it has been accomplished numberless times within the last twenty years, if every scientific announcement of the fact is to be credited—we have been deceived so often that incredulity is somewhat pardonable. I made the assertion that these gases could not be solidified on the authority of at least half-a-dozen standard *Chemistries*, but I will not dispute the point, as it is of no moment. I admitted in last letter that all gases might be solidified.

Referring to the "waters-above-the-earth" theory, a scanty glance through the first chapters of Genesis will show "Hallyards" that its origin is shrouded in no ambiguity, and we are not even dependent upon the Hebrew records for its exposition; it was an universal idea.

Alex. Mackie.

[The question of the possibilities of past life in the moon though suitable enough for suggestions, is not one for discussion. We can fancy many things but can establish nothing.—There can be no doubt that there is more moisture usually in the air over hot regions than over cold ones. Oxygen and nitrogen have both been solidified,—and by more than one process.—R. P.]

EVOLUTIONISM.

[1879]—So much has been lately written in Knowledge about the Darwinian theory, that perhaps I also may be allowed to raise a point or two that seem as yet untouched.

I cannot help thinking that the reason why Darwinism is so generally accepted at present is because it is a theory so admirably suited for our present phase of thought. In these days of inventions, of rapid advance in science and in material civilisation, when the ideas of all instinctively turn, whether they will or not, in the direction of the unlimited development of human resources, the notion even of an inexpansible millennium becomes too narrow for us, and in such an age this new evangel of progress could not fail to have an immense following. A century ago, had there been found a historian who could philosophise on history as we do now, and could he have foreseen the enormous strides that have lately been made in science and its application to material resources, he might have been able to predict that a theory of this nature would arise—he might even have laid down some of its main characteristics. The moral to be drawn is this: the more completely a theory is the creature of its age, the more deeply ought it to be distrusted.

Again, it really seems to me that the "struggle for existence" has too much to carry. It appears to be forgotten that slight variations (the only kind admitted) are *absolutely and totally* ineffective in this struggle because their results are so small. To illustrate: I wear moustaches on my lip which in eating continually get inconveniently into my mouth, but are most ungraceful

when clipped short; nor will I take the trouble to shave. Is it, then, to be supposed that in the struggle for existence the men whose moustaches incline more outwards will have so much the best of it that, after many hundred—or, if you will have it, let us say, million—generations, all mankind will be found to have their moustache hair pointing towards the outer edge of their eyes?

Then, again, animals have the power of adapting themselves to circumstances. Everybody will, I suppose, admit that. It manifests itself in many ways, as when a cat takes on a thicker fur in cold countries, &c. In such cases there is no time for direct evolution to come into play; such adaptation sometimes takes place in the life of a single animal. Now this power itself, say the Darwinians, is a product of natural selection, since the possession of such a power is evidently favourable to the species. But when we come to look closer it becomes plain that this power in animals is in itself quite sufficient to account for the whole process of development. It is quite as effective for that purpose as the theory of natural selection could be. Darwinianism, therefore, instead of being the great panacea for the explanation of everything and everybody, is in reality an explanation of nothing but this one power. But by such a limitation Darwinianism loses its *raison d'être*, for the only justification of a hypothesis is its power of co-ordinating a great number of varied phenomena.

P. J. Beveridge.

[Mr. Beveridge's letter contains ample internal evidence that his knowledge of the theory of evolution is derived from hearsay, and that his personal acquaintance with it is of the very haziest and most imperfect character.—Ed.]

[When one considers Darwin's unwearying zeal and industry in collecting and observing facts, his marvellous patience and skill in analysing them, and his freedom from prejudice in interpreting them, such facile and flippant comments as are passed on his work by some who manifestly have never read with attention ten pages of his master works, are amusing—to speak mildly of them.—R. P.]

WHAT LIES OUTSIDE THE MECHANISM OF THE UNIVERSE?

[1880]—Mr. Proctor, in his clever article entitled "George Eliot on Mental Decay," has sufficiently exposed the false reasoning due to theological bias; but I think it will be found that in enforcing his argument he has given undue prominence to mechanical doctrines, and has incurred the risk of being misunderstood upon a very important subject. It is very natural to overstate a truth when you have antagonists who can only dogmatise and assert; and if I am right in my assumption, I, for one, can sincerely sympathise with the able Conductor of Knowledge in this respect. But I presume (and I hope I am right) that Mr. Proctor believes in something else than pure mechanism. It would not be unscientific for him to suppose with Herbert Spencer that there is an unknowable and infinite energy underlying phenomena. [Why this is the very religion of science, the soul of the worship of science, the foundation of the whole system of duty inculcated by science. Where is the man of science who does *not* believe this?—R. P.] There is nothing theological in the conception, and it would be more in harmony with facts than causeless mechanism. Supposing this to be the view of Mr. Proctor, it does not appear in his arguments; and I call attention to the circumstance that he may correct any misconception, if there is such.

In supporting George Eliot's views by illustrations of his own, drawn from music, he makes B. say:—

"And yet, after all, there are musical passages, whose beauty seems independent of the material qualities of the instrument."

To which A. answers:—"Not one. . ."

C. then asks:—"So music depends on mechanism after all?"

A. replies, and through A., Mr. Proctor:—"Undoubtedly. It depends absolutely on mechanism."

Now, I contend that this is not quite in harmony with the facts. If mere beauty of sound were concerned the statement would be perfectly true, but if musical thought and conception is referred to as a part of music—which it is unquestionably—then it is not true at all, or only to a small extent. Beethoven was deaf the greater part of his musical life, and had to write without hearing an instrument. Of course, he mentally heard them, but instruments did not create the music which came unbidden to his mind. *His* was the motive power, as was also that of Mozart and others, which created the mechanism of music. They left the art where they did not find it, they created a necessity for more perfect appliances. The modulations which they introduced into music made the equal temperament necessary, and the combinations of tones they conceived altered and fashioned many physical features in the art.

I may have misunderstood Mr. Proctor, but it seems to me that he has unduly emphasized the mechanical element in nature. Certainly, one school of "materialists" lay great stress upon this feature; but the other school—to whom, I think, Herbert Spencer belongs—while admitting final causes to be unknowable, yet admit in that unknowable element the potency and creative energy for all we see.

Gamma.

[Although I think it unnecessary to explain that I meant what I clearly said, I insert "Gamma's" letter, as presenting well certain points which are often misunderstood. I said music depends absolutely on mechanism, not music *is* mechanism. The same mechanism may be used to bring out the music of a Bach a Beethoven a Handel or a Mozart, the melodies gay or sad which move the musically untaught, the wearisome iteration of the common sorts of dance music, or the meaningless thumping of a child. Every one of these products depends on the mechanism. That they are so unlike shows that there is something outside the mere mechanism. As my object was specially to show that George Eliot's words had not the meaning which "Gamma" thinks may be found in mine,—and as I definitely showed this by the illustration I derived from music (note especially the distinction dwelt upon in the last paragraph but two), "Gamma's" elucidation was unnecessary. But being good, in itself, let it stand.—R. P.]

"DOUBLING UP YOUR HAVES."

[1881]—I have a great respect for Mr. Proctor's opinions on most subjects, but I must confess that I entirely agree with "Hallyards" in considering "I should have like to have seen" an odious phrase, and I am surprised to find Mr. Proctor defending it. And yet similar phrases are constantly used, not only in common parlance, but in books otherwise well written. Most persons will confess it is incorrect when their attention is called to it, but a few maintain that all the verbs in a sentence should be in the same tense. Mark Twain calls it "Doubling up your haves," but then at present he is not regarded as an authority by Knowledge. A similar expression is, "I meant to *have gone*," when what was originally "meant" was "to go."

E. C. H.

[I did not defend the phrase, and I never use it. What I said was that it conveys a certain meaning not quite conveyed by any other form of expression. Mark Twain is not an authority here on science; but a writer of so much experience is necessarily an authority on the use of words and forms of expression.—R. P.]

"THE WELL OF ENGLISH UNDEFILED."

[1882]—Much has been said of late respecting the loose and inaccurate way of speaking and writing common among people who presumably are fairly educated, and I may perhaps be allowed to call attention to the following vulgar illiteratisms:—"Different to," for different *from*. "Those sort of people," for *that* sort. "Either side of the way," when the sense clearly indicates that *each* should be used; an error very common among popular authors. "I shall have much pleasure in accepting," &c., instead of I *have*, *cum multis aliis*, but the above are among the most general errors of common parlance. With regard to pronunciation, one may often suppose that the rule in our dictionaries that the comma after and above a syllable indicates that it is accentuated is not generally understood, or we should not so often hear such mistakes as, centrifu'gal, contripe'tal, Ser'apis; and among the clergy, inspi'ration is far more common than the *i* in the second syllable pronounced like *e* short.

These are a few indications of a faulty system of education in the past, which in large schools especially apparently took for granted that children were intuitively gifted with a fair knowledge of their own language, or were grounded as infants.

H. A. Bulley.

P.S.—I heard the present Bishop of London called pedantic for rightly pronouncing i'solate, is'olate.

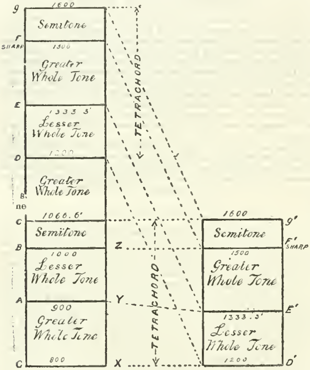
[Prof. Young, of Princeton, N.J., assured me that "different to" is a specially English mistake. It is such a bad mistake that I can hardly think it as common in English writing as he says he finds it. "Differing with" a person is another bad mistake. "Averse to" is not so bad, in fact custom has not yet established "averse from,"—"averse" may be equivalent to "adverse," and so the "to" justified. And certainly, "I am averse from litigation" is less supported by custom than "I am averse to litigation." "Either" for "each" is admissible in poetic descriptions, whether in metre or otherwise. "On either side there lay a gulf profound," "on either side stood Death in awful form,"—here certainly "each" is really meant, but "each" would be utterly prosaic. "I shall have much pleasure" &c. though not strictly correct, is an idiomatic way of conveying the idea that the result of accepting the imitation *now*, will be pleasurable *hereafter*. I have never heard centrifúgal or centripétal.]

DE GUSTIBUS—MUSICAL TEMPERAMENT.

[1883]—When the classification which I put forward in letter 1742 is taken into account—namely of (I.) physical excitement, (II.) intellectual satisfaction, and (III.) associations, &c.—as three elements in questions of taste, I think many quotations from critics in painting might be made in justification. The early Florentine and Roman schools will seem to have more of the spiritual, the Venetian somewhat more of the sensual element, and the Flemish a great deal more of the sensual. But at present I have to offer an illustration from another art, where, for want of observing the above distinctions, a controversy remains open, in which mathematically-exact philosophers appear arranged on the sensual side of the question, as opponents to practical professors, who take the intellectual side; a curious position of things.

My present subject is Musical Temperament; which I propose to take on the way—a roundabout way as it may seem—towards resuming the consideration of Symmetry. (I must still use the word loosely for convenience, notwithstanding the objections of "Another Old Draughtsman"—letter 1797—which will deserve regard at another time.)

The subject may perhaps be new to some of your readers, and I proceed to give an elementary statement.



If the distances G X or A Y represent a second of time, and if in that time a sounding body, associated with the line G X, make 800 audible vibrations, while at A Y are made 900, and at B Z 1,000 vibrations, the three effects are such as are known respectively as the keynote of a musical scale, the so-called second, and the so-called third of that scale.*

In these cases, with low common measures, such as 8, 9, and 10, the notes have readily-apprehended relative individualities; and, moreover, imaginary distances, as A G or B A, become readily conceivable to the musical faculty, like distances extended between the lines of an inscription or between stars in the sky. The distances between the lines G X, A Y, or A Y, B Z, are called in musical language intervals of major seconds, or whole tones, by a confusion of a word for a sound with one for an interval between sounds.

The acoustic philosopher discriminates further, and distinguishes the greater tone A G from the lesser tone B A. Perhaps he plumes himself on superior accuracy, because the amount of the interval is according to the ratio of numbers of vibrations, and 8 : 9 is greater than 9 : 10.

* The key of G has been chosen, because at the high pitch of modern orchestras the note G above the treble stave would be very close to 800 vibrations per second. If I had selected 80, 90, and 100 vibrations they would have constituted deep bass notes; 8, 9, and 10 per second would not have been musical at all.

The foregoing numbers illustrate "Just Intonation." Recourse might be had to tuning A Y, so that it should consist of 895 vibrations instead of 900. In that case as (barring fractions) 800 : 895 :: 865 : 1000; the two intervals G A, A B will be equal. This will give an idea of what is termed Equal Temperament in opposition to Just Intonation.

In practice, however, something else must be done, for B Z itself must be tempered; and we must have B Z at 1008 vibrations, and A Y at 898; in which case 800 : 898 :: 898 : 1008. With which proportions musicians seem generally content in the present day, in the case of keyed instruments.

But sweetness of tone is associated with low, common measures of the ratios of vibrations. The "3rd" so called, of 800 and 1000 vibrations, in proportion 4 : 5, is especially sweet; more so than 800 : 1008; whose lowest terms are as high as 50 : 63.

How do these things concern the hearer? The sweetness is of sense, sensual. The individuality of 1008 vibrations in opposition to 800, results in an interval, only by a trifle less intelligible to the understanding than the very sweet interval.

If the intellectual is to give way to the sensual, we want a diatonic octave scale with these intervals, viz., keynote to 2nd, a greater tone, with the ratio 8 : 9 vibrations; 2nd to 3rd, a lesser tone of 9 : 10 vibrations; 3rd to 4th, a semitone of 15 : 16 vibrations; then a greater tone followed by a lesser, then a greater, and then another semitone. These constitute a justly-intoned scale (G g). But the system of music (not acoustics) implies liberty to a composer to lead hearers, to draw intellectual analogies between certain sets of notes called tetrachords.* A tetrachord consists of two larger intervals (tones) followed by a smaller (semitone). Upon the equal temperament system these analogies may be minutely true. Upon the system of just intonation they are loose analogies. Thus, let the notes of one tetrachord justly intoned be put on a level with another, dismounted from the upper part of the same octave—G C on a level with D′g′—and let cross-lines be drawn between the corresponding parts, G X D′, A Y E′, &c. It will then be seen that the line A Y E is crooked. The justly-intoned tetrachords are not symmetrical.

But if the tetrachords had been equally tempered, the line A Y E′ would have been straight, and the "canonical" imitation of a musical phrase in one group of notes G C by another group D′ g would have been a close one. Thus the intellectual understanding of music is served as well by equal as by just intonation, however the unsophisticated outer sense of hearing in a few persons of extraordinary delicate sensation may be offended by it.

The third element, of association, may unite sometimes with the intellectual branch, sometimes with the sensual. And if the association be with the past sensations of childhood, or again be a lingering relic of ancestral sensations, there seems less coarseness than the word "sensual" generally implies. Time purifies it.

A. O. D.

IS THE GAME OF DRAUGHTS PLAYED OUT?

[1884]—I was much amused by a sentence in letter 1856. "The game of draughts is now played out." On referring to the *Encyclopædia Britannica* I find that the writer of the article "Draughts" practically says the same. He says that the game is exhausted, and that the best reply to every possible move is known. I wish to call your attention to a few facts which will show the falsity of this statement. There are in England and Scotland about twenty newspapers which contain a Draught column. Week by week these columns publish *new* play. There is also a weekly magazine devoted entirely to draughts, and it contains weekly a large amount of original play. Recently a pamphlet was published containing sixteen pages of new and original play on an hitherto unexplored opening.

In April, 1884, an international match was played between England and Scotland. Both countries were represented by the finest players to be obtained. The result was—England, 7 won games; Scotland, 36 won games. Would this have been so if all the best moves had been known? Not one-hundredth part of the possibilities of draughts are yet known. All the best players are agreed that draughts is yet in its infancy.

The writer of the article in the *Ency. Br.* cannot have had any personal knowledge of the game. He is unknown to players whose memory can carry them back twenty or thirty years.

A. E. HODGSON.

SMELL-CLOUDS.

[1885]—We see the vapour of water travelling in well-defined masses, and sometimes are plunged into them. Hence we do not dispute their consistency and locomotion. We do not see other

* Let any who doubts, deliberately consider the definition of a "fugue," and particularly a so-called "real fugue," in music.

masses of gas, and for this reason we do not realise to what an extent such lumps of rare matter hold together and travel.

In 1882 I addressed to *K.* a speculation as follows. After a violent westerly gale I *sometimes* remark here for days after an entirely novel odour like primeval forests. I have conferred with natives, and, as usual, they give an explanation which cannot be the true one—*i.e.* that it comes from kelp-burning at Noirmantier, 10 miles off. I point out that we almost always have the wind just from that quarter—S.W.—*without* any smell—(2) that when we have this new perfume, it is after a *W.* gale of exceptional force—(3) that the smell is not kelp, but pines, and general verdure.

My suggestion to *K.* was that this smell had come all the way from America. If caught in the centre of a cyclone, I see no reason why it should not pass the Atlantic, kept entire by its very rotation. I instanced two remarkable cases of cohesion of odorous gas. At noon on a calm sunny winter's day I passed four or five young ladies seated on a stone bench. I noticed as I passed an abundance of strong perfume. They would not stay there long; an hour, at most. Yet, when I repassed after dark, I found the perfume quite as strong about the bench. On the same spot a few years before I passed and repassed several times through an invisible cloud of wood-smoke, deliciously odorous. This must have come from a good distance, for there were no inhabited houses near.

My letter was not noticed in any way. It no doubt seemed mere extravagance.

In June 1884 a friend lent me a N.Y. or Detroit paper (which I regret to have lost) wherein it was reported that a ship's crew had been almost suffocated by meeting, 400 miles from the nearest land, a dense bank of wood-smoke. If smoke will travel 500 miles, why not 2,000 for a backwoods bouquet?

Last night on going out I felt myself in the poisonous fumes of a lime-kiln. There is one a mile to windward. In half-an-hour there was no more smell. The cloud of gas had travelled on.

I have stood on Killiney Hill on a windy day, and seen Dublin quite free of smoke, while over Howth and Sutton there hung a black pall, which was the smoke of Dublin, detached. I have smelt the smoke of Dublin twenty miles off, and have been told that sea-foam has been found in the centre of Ireland. At Brompton after long-prevailing E. wind I have found the air not better than that of Fleet-street. This might turn the scale in favour of death, in the case of a very delicate sufferer; but I have always found physicians calmly supercilious about any such obscure causes of variation in strength. Hallyards.

SOMETHING ABOUT THE SKIN-CASTING OF SNAKES.

[1886]—During a service out here of thirty odd years, I have come across snakes, I may say, by the thousand; and I have met them in the most unlikely localities, and most extraordinary positions.

Some of the latter they could not possibly have reached without using their ventral scales to assist them in climbing—*e.g.*, a mud wall; or, as the pedal-scales of lizards to occasion a vacuum, and enable the individual to ascend the interior of a glass jar.

The most extraordinary locality was finding a poisonous snake coiled up between the seat and lid of a dak-bungalow night-stool; and the next, the double roof of my brougham; and dropping a cobra from the sleeve of my wife's velvet jacket, which had been hanging on a dress-stand.*

And the localities in which I have found the exuviæ of snakes have been equally singular. Sometimes I have found them amongst the entanglements of a rose-bush, and entire, too. The krait, a small and very poisonous species, is a snake of literary attainments, and affects book-cases, and I have found its skin on the top of a shelf of books; I have found a cobra-skin left as a card on the floor of my drawing-room; I have met it stretched out on the broken brick-ballast of the railway.

Apropos to this, it was an old tradition out here that snakes abhorred rough places, and, therefore, our houses used to be surrounded by broken stones or bricks. I soon saw, from meeting snakes in these so-called protected houses, that this was a delusion, and that animals which have no legs, wings, or arms, can be met with as freely up a tree as on a house-top; and that they can progress as easily along the face of a mud wall as on the ground.

But I am wandering from my subject—the exuviæ of snakes, or skin-casting.

The books say that because the scale and corneæ plates are always found inverted, this wonderful process of exuviation must commence at the tail and end with the head.

To explain the book process I must resort to a rough diagram. Having shrunk within its skin, and thus loosened it, that around the jaws cracks, and the snake begins to wriggle forwards, the tail adhesion being as yet perfect; half-way through the process the book position is shown roughly in Fig. 1 (the dots indicating the skin), and it can be imitated by passing a needle with a knotted

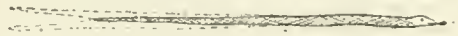


Fig. 1.

Fig. 2.

thread inwards through the tip of the finger of an inflated glove, and then pulling gently on the thread, as shown in Fig. 2. The process of inversion goes on gradually, and ends by the tail passing through the skin of the mouth; it is then detached and the exuvium is left behind. But how this extraordinary detachment takes place, the books don't say. As the result of this process the mouth of the skin is left exactly opposite to the point of exit of the snake—*i.e.*, if the snake began exuviating with its face to the East, the mouth of the skin will point to the west.

All this is too complicated for the real simplicity of Nature's work; exuviation is rendered necessary by the snake having outgrown its skin, which is therefore dispensed with, and the process is exactly similar to that seen, say, among silkworms, only that in their case the exuvium is left behind crumpled up, and not straightened out. I have never seen anguine exuviation, but, judging from that of caterpillars, the loose skin is slowly thrown off by a series of undulatory movements.

Charmers, out here, carry about their snakes, cobras generally, and sometimes pythons, in circular baskets, and when skin-changing comes on (at the commencement of the cold weather), the poor creatures are in great straits, and can only relieve themselves by rubbing off flakes of epidermis against the sides of the basket. In the natural process, the inversion of the corneæ and scale-plates, is, I believe, due partly to cuticular contraction in drying, and partly to atmospheric pressure. R. F. Hutchinson, M.D.

Pachmari, July 5, 1885.

LETTERS RECEIVED AND SHORT ANSWERS.

Agricola. Not the very slightest. It is stuff and nonsense from beginning to end.—Rev. Lacy H. Rumsey. Thanks, but more than one such table is already in existence. *Vide* (for example) pp. 886 to 891 of Chambers's "Descriptive Astronomy," De Morgan's "Book of Almanacs," &c., &c. Kindly note, too, the paragraph, in capital letters, which concludes those heading the Correspondence Columns.—Augustus J. Harvey opines that there are not enough clubs, societies, associations, and institutions in London and other cities and towns in the kingdom; but, in view of the collapse of so many of such establishments, I fear that he will get but few people to agree with him.—John Hampden. Do you seriously expect for a single instant that any *gentleman* can, or will, take the slightest notice of such unmitigated ruffianism? Mr. Wallace can only possibly treat it with that supremely contemptuous silence which it deserves. [So much from my friend the acting editor. Mr. Hampden's letter has been forwarded to me, and I may as well give my opinion also. Mr. Hampden writes to me that he has called on a gentleman whom he describes as a friend of mine (but whom I have never met), that he tried to insult that gentleman most grossly, and that failing in this, simply because Mr. Hampden's violence was beneath a gentleman's notice, he distributed over eighty offensive handbills in the neighbourhood. Mr. Hampden seems to implore me to notice what he is capable of in his own special line. He asks my opinion how a gentleman treated as he has treated one of the most esteemed men of science of the day might be expected to act. My opinion on this point is that this gentleman displays marvellous self-possession and dignity. The *probabilities* I should imagine were largely in favour of a sound horse-whipping being the reward of the conduct Mr. H. describes, assuming his account correct.—R. P.]—W. Woolston Moodie. The mathematics essential for the reduction of astronomical observations are plane and spherical trigonometry, the use of logarithms, and interpolation by differences, a competent knowledge of all which is a *sine quâ non*. It would be advantageous, too, to master the method of least squares, for obtaining the most probable value of a large number of varying observations.—Dr. Lewins. I have not inserted your more

* [My own father-in-law, during the time his regiment was stationed in India, found a "tic-polonga," a most deadly snake, in his flute!—Ed.]

recent letters, because they simply consist of the reiteration of the previous exposition of your thesis admitted into these columns. Judging from the correspondence (or rather utter absence of it) elicited by your letters and those of Miss Naden on the same subject, the seed fell upon but barren ground indeed. For some reason which I will make no attempt to fathom, the readers of Knowledge do not appear to care two straws about Hylo-Idealism.—Alex. Inglis. I do not know whether such forecasts as the late Lieut. Saxby used to publish are now sold. I imagine that if sold they can hardly be "got for a payment" small enough to represent their value, which would be somewhat less than nothing (at least if the purchaser put faith in them).—W. C. Penn. Questions can *not* be answered by post. Yes; great faith is put in the moon as an index of weather by country people; also in fortune-telling, and other foolish fancies.—J. Bailey. Certainly, *I* should understand upwards of one hundred to mean more than one hundred, not less. But never mind *me*.—W. N. Ridlington. Editor has nothing to do with such matters. Try local newsvendors.—F. W. H. and Meter. From opposite sides you deal with the question of necessity and supreme law. To one I answer that if necessity makes a man objectionable, it becomes necessary that he should be corrected. We may, as you seem to suggest, feel sorry for him, because of his necessity; so we might feel sorry at having to shoot a tiger who had been driven by necessity to propose eating us. To "Meter" I note that his or her view, the ordinary theological view, is open to some trifling objections. If only one view of right and wrong had commended itself to the nations, the idea that that view was of supernatural origin, or divinely inspired, would run to some degree on all-fours. But as this is very far from being the case, as multitudinous ideas about right and wrong prevail in different nations, and are nearly all thought to be of divine origin, a certain degree of difficulty is introduced. However, though Mr. Foster was allowed to examine here the system of ethics arising, as Mr. Herbert Spencer has shown, out of the process of evolution, and commending itself as best for the progress and welfare of the world, he carefully refrained (you may have noticed) from discussing the question of a divinely-communicated moral law. The subject is one which cannot be dealt with in these columns.—G. W. Dodds. Do not know. Surely the makers or sellers would give you the best advice on such points.—R.F.H. I see no great difficulty about the unfortunate condition of the Dumba Sheep. If that creature had by ordinary evolution, acting simply through natural selection, reached that unsatisfactory state, of course it would be strange to consider how a race had actually been brought to its end by a process which usually fits races better to contend with adverse conditions in their surroundings. But with domestic animals, artificially selected and treated, such peculiarities can readily be understood. The Sandwich Islanders are a case in point; for their race would come to an end, if my information is correct (and it comes from their king), but for special surgical assistance.—W. H. Bulpitt. Thanks.—J. H. M. The reviewer's innocent remark must not lead to a discussion about the innocents. The subject is outside our range, and few, I fancy, care much about it.—F. West. Have forwarded your article to the writer who deals with inventions.—R. A. H. We shall not have space, I fear, for the papers you kindly suggest. They are a little outside our line. (With regard to a personal interview, your chambers, though near the publishing office of Knowledge, are not within fifty miles of the room where I am writing these replies.—A. Brothers. The angle subtended by the image does not change at all. Surely the result observed requires no explanation. What else *could* happen?—S. B. B. The puzzle is well known. All the cut squares, though they seem to fit so as to form other squares, really form incomplete figures.—Commentator. Your "Darwinism debated" is more than debateable.—W. Reynolds. Letter should have been sent to "Mephisto." Your corrections are right; but surely no one could be for a moment in doubt.—G. G. G. Neither do I (R. P.) know the author of those lines. The thought is tender and touching, the form occasionally rough,—as in the line "And lovedst all and renderedst good for ill." Does not the *popular conception* of a future life, so viewed—as all men who have loved and lost must view it, if they accept it—seem unutterably sad? Even the mere poetic presentation of that which my reason rejects is for me inexpressibly saddening. Thanks very much for the stanzas.—R. I. P. "*Has* Hallyards ever been a certain successful novelist."—Alex. Mackie. A slight change.—Robert Lewins, M.D. A story occurs to me (R. P.) apropos of your theory of Hylo-Idealism, which I may throw in here in reply to your latest communication—received since the Acting Editor replied to you as above. A man in "the States" was commenting unfavourably on the Royal arms of England and their heraldic supporters. He objected definitely to the Crown, and effusively abused the Lion,—but his remarks on the Unicorn were comparatively vague:—"*Gawldarn* a *Unicorn*, any way" was his sentiment in regard to that highly idealistic creature. I think the general interest in Hylo-Idealism is equal in enthusiasm to that felt in the Unicorn of Heraldry—there or thereabouts.—The letter on M. Renan and G. Eliot trenches on dangerous ground.—P. M. Yearsley. Quite agree with you. But oh! don't let us invite that one to express his views. One who "never seems at a loss on any subject" is seldom to be trusted.—One who is not Connected with the Vegetarian Society, the Study of Sun-spottery, the Royal Astronomical Society, or a Certain Well-known Weekly Scientific Paper—what a *nom-de-plume!*—is bewildering. As he sends anonymous impertinence, he probably *is* connected with the Vegetarian Society, &c., &c. But he may be merely crazed. Who is "*the* astronomer who is going to regenerate the world by harping on with his ideas about 'sun-spottery'?" "One who, &c.," implies that the Conductor of Knowledge harps on that way. But Knowledge has had very little to say about sun-spottery, and that little has not come from the Conductor. In former years, I grant "One who, &c.," the Conductor of Knowledge exposed the trick by which some impecunious persons tried to get money and position out of ingeniously-imagined influences of sun-spots on our weather: but the snake was not only scotched, it was killed at that time; long before Knowledge was started. Who hopes to get money out of that dead trick *now?* What is there, by the way, about sun-spots in Knowledge for August 7th, that "One who &c." points to that number? Does he in any way or degree know what he is talking about? I imagine not. From the rudeness of "One who &c." to the contributors to Knowledge, I imagine he has wished to contribute and been found—naturally—unequal to the work. His writing—though disguised—seems familiar to the conductorial eye.—W. Paton. I (R. P.) am most emphatically of your opinion. Within a few weeks you will have good evidence on that point.—J. E. Walker. It is most improbable that the indistinct articulation is caused by the tubes. Possibly the carbons of the distant microphone have "set," or the fault may be that the diaphragm in the home receiver is out of adjustment. The best plan would be to ask the lessors to overhaul the apparatus.

Notice.—In future weekly numbers of Knowledge, the answers to correspondents will occupy much reduced space. We can no longer undertake to answer all questions addressed to us, or to explain why letters intended to be published are not suitable for our columns.

Our Whist Column.

By "Five of Clubs."

SOLUTION OF PROBLEM.

I FOUND when I reached England (for it is of course now no secret that "Five of Clubs" and the "Conductor of Knowledge" are one and the same person) that I had not sent, as I supposed, the solution of the fine double-dummy problem which appeared on June 26. I had written a full analysis of the problem, and had certainly intended either to send it with the problem, or with the next batch of papers forwarded from my home in Missouri. But it is clear I did not do so, and that analysis is lying somewhere *perdu* among the multitudinous papers, letters, pamphlets, maps, &c., &c., &c., which I have brought to my home in England. This is the more unfortunate as I find very few of our Whist-readers have succeeded in solving the problem. Of course many, knowing that it originally appeared,—as I have recently learned—in the *Field*, would not have had anything to say about it, having already either solved it or seen the solution. But from the letters of many it appears to have been freely tried, and with very little success. Some who have been thus foiled have objurgated me very freely for the omission to give the promised solution, one or two deeming the delay merely a clever trick on my part either to cover some mistake in the problem or to increase the number of readers of Knowledge. I should have thought the latter effect would certainly not be produced by any trick of the imagined sort, but quite the reverse; while as for delay being a satisfactory way of trying to hide a mistake, I have observed that the longer correction is deferred the worse are the effects of a mistake, and my own constant rule has been to acknowledge any mistake I may have made as quickly as possible.

However, there is no mistake about this particular problem. Here are the hands and conditions:—

Spades—7, 6.
Hearts—Kn, 4.
Clubs—A, 3.

B

Hearts—Q, 9.
Clubs—Kn, 8.
Diamonds—Kn, 6.

Y

Hearts—10, 5, 3.
Clubs—6.
Diamonds—Q, 7.

A

Hearts—A, K, 6.
Clubs—10.
Diamonds—10, 9.

A leads, and *A-B* are to make all the tricks, let *Y-Z* play as they may. (A correspondent remarks that I did not originally mention that Spades are trumps, though that was obvious from my comments; but it has been our constant rule to indicate the trump suit by the use of italics, and the Spades were thus marked, clearly enough for all the Whist readers of Knowledge, as trumps.)

Singularly enough this problem which seems so difficult, yields at once when dealt with—not as a puzzle but—as a position in actual play. Following correct Whist principles the solution of the problem is simply the play which a good double-dummy player in *A*'s position would certainly follow. I was nearly a quarter of an hour working unsuccessfully at this problem as a puzzle; but so soon as I tried the experiment, which I have occasionally found successful with Mr. Lewis's masterly double-dummy problems—of playing according to the best perception of the position, I solved the problem at the first attempt,—(first on that line, *bien entendu*).

Observe: *A* has five certain tricks from the two trumps, the Ace, King of Hearts and the Ace of Diamonds; he may get a sixth trick either in Hearts if *Z* can be made to discard a Heart, or if *Z* can be led through in hearts after first trick in that suit, or in Clubs if *Y* can be made to discard a club, or in Diamonds if both *Y* and *Z* can be made to discard their last Diamond after one round trumped by *B*. To keep open these chances, *A-B* must retain the power of leading through *Z* in Hearts after one trick has been taken in the suit, and this lead *must* be with *B*'s small heart or *A* can never make his tenace over *Z* except on sufference; while also, obviously, the longer *A B* keep back the lead from their two card plain suits the better chance there will be of forcing discards from *Y-Z* in these suits. Clearly then the most promising play for the first trick is as follows:—

A	*Y*	*B*	*Z*
HK	H9	HKn	H3

No Whist player of any experience would hesitate for a moment about the play of the Heart Knave, seeing that *B*'s retention of the card would obviously leave *Z* free, when *B* eventually led the Knave, to play his lowest; when, if *A* captured the Knave, the third trick in Hearts would go to *Z*; while if *A* failed to capture it, *B* would have no Heart to lead and must lead a losing Club. Nor can we doubt that it is best for *Y* to play the Heart Nine. On one possible line it is true *Y-Z* might get a trick through *Y* playing the Queen; but only by *A-B* playing incorrectly.

One of his five certain tricks has now been taken by *A*. Of course he must not now go on with Hearts. Equally obvious is it that he must not lead his Club; for that is a card necessarily valueless in *A*'s hand, and it may become a matter of importance to be able to discard this absolutely valueless Club to *B*'s lead of a trump. Everything in such cases depends on holding open as long as possible the lines of play available.

Therefore the second lead *must* be the Diamond Ten, to which *Y* and *Z* each drop their smallest Diamond, which *B* trumps with the Six.

It is now *B*'s turn to lead. He clearly must not lead the Club Ace *here*, for the same reason that *A* should not lead Club at the preceding trick. Equally clear is it that he must not lead a Heart; for *A* would be forced to play his Ace *Z* retaining his Ten, and securing one trick for *Y-Z* whatever *A* might lead.

Therefore the third lead *must* be *B*'s long trump. Clearly *Z* can lose nothing by discarding his single Club; *A* can lose nothing by discarding his. But what shall *Y* discard? If he discards his Heart Queen, *A*'s tenace over *Z* is made safe, *B* simply leads his Club Ace, making the fourth trick, and then a small Heart, *A* making the two remaining tricks in Hearts. If *Y* discards a Club, *B* makes the fourth and fifth tricks with his Club Ace and Three, the sixth going to *A*'s Heart Ace. It remains only for *Y* to discard his Diamond Knave.

A-B have now made three tricks; but even yet *Y-Z* seems to have command over all three plain suits. They have between them,—

Second and third best Hearts with the fifth best,
Second and third best Clubs,
Best Diamond,

moreover the second and third best Clubs are in one hand, and the third and fifth best Hearts in one hand. For all this *A-B* have the game in their hands, and their play is now quite simple, since *B* obviously must not lead a Heart.

The fourth lead *must* be *B*'s Club Ace. *Z* must either discard a Heart or his Diamond Queen. If he discards a Heart, *A* discards his Diamond Nine, and *B* leading the small Heart *A*'s Ace and Six make the remaining tricks. If *Z* discards his Diamond Queen, *A* discards his Heart Six, and on *B* leading a Heart the remaining tricks fall to *A*'s Heart Ace and Diamond Nine. *Y* of course follows suit with Club Eight.

The full solution runs then as follows:—

	A.	Y.	*B.*	*Z.*
	1. H K	H 9	H Kn	H 3
	2. D 10	D 6	S 6	D 7
	3. C 10	D Q	S 7	C 6
	4. H 6	C 8	C A	D Q
	5. H A	H Q	H 4	H 5
	6. D 9	C Kn	C 3	H 10
or	4. D 9	C 8	C A	H 5
	5. H A	H Q	H 4	H 10
	6. H 6	C Kn	C 3	D Q

The student will find it a useful exercise to study out why it is that though Club Ace, and Spade 7 are both winning cards, it makes all the difference between winning and losing whether *B* at the third trick leads one or the other. The reason will be found to be that if *B* leads the Club Ace first, *A* at the fourth round has to decide on his discard before knowing *Y*'s play: but if the Ace leads the fourth round A knows already what must be *Y*'s play.

ANSWERS TO CORRESPONDENTS.

F. H. Lewis.—Many thanks. The words in parentheses would have been better omitted. I was dealing, however, at the outset with a purely imaginary case. I was thinking of an exposure by accident, to third player *only*,—as for instance of early in the game fourth player had held his cards so carelessly that third could not help seeing the Ace.

J. Osborn.—There is no misprint in the Double Dummy problem given in Clay. Don't give it up: but if you must you will find the solution in "How to Play Whist" (Longmans).

An Indifferent Whist Player, Constant Reader, P. C. B., J. R. L., Emu, L. K., Scatterbrain, and others. Solution and explanation of delay now given.

Solutions of Double Dummy problem by Peterkin, S. Jones, Marlborough, K. J., and Two of Clubs all correct; all others wrong. The six tricks cannot be made if *B* does not play the Knave first round—that is, if *Y* and *Z* play properly. Nor if *B* leads Club Ace third round.

J. L. P.—Not very wonderful that I missed a problem in the *Field* for January 31, considering that between December 1884 and March 1885 I was on a lecture tour which carried me from the extreme north-east point of the United States, through New York, Washington, and the Southern States, to Texas. The *Field* does not reach one in many of the places I then visited.

W. J. Wallace.—The difference between the frontispiece of "How to Play Whist" and the description of the problem in the body of the book is absolutely without importance—the cards interchanged between *Y* and *B* being of equal value so far as trick-making is concerned.

Home Whist, a short and simple introduction to the game of Whist, with all the latest developments, including the American Leads, and the Echo in Plain suits, by "Five of Clubs" (Richard A. Proctor), is now in type and will shortly be published by Messrs. Longmans. It is illustrated by eight games showing the play of four sets of hands, first in the old-fashioned style of Home Whist, and secondly according to true Whist principles. These will serve as an introduction to the forty games illustrating "How to Play Whist," by the same author (Longmans).

Our Chess Column.

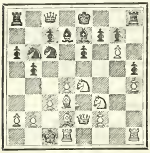
By Mephisto.

ILLUSTRATIVE GAME No. 7.

CONTESTED in the Hereford Tournament of the Counties Chess Association, August 12, between Herr Schallopp, of Berlin, and Mr. J. H. Blackburne. A remarkably well-played game, one of the best in the tournament. It is an excellent illustration of the advantage to be gained by vigorous play, against defective development in the Opening. It also contains an attack against the French Defence, which, to the best of our recollection, we have never before seen attempted in practical play.

White. Schallopp.	Black. Blackburne.
1. P to K4	P to K3
2. P to Q4	P to Q4
3. Kt to QB3	Kt to KB3
4. B to Q3 (a)	P × P (b)
5. Kt × P	Kt to B3
6. Kt to KB3	B to K2
7. P to B3	B to Q2 (c)
8. B to B4	P to KR3
9. P to KR4!	P to QR3 (d)
10. Q to K2	Kt to Q4
11. B to Q2	P to QKt4
12. P to KKt4 ! (e)	Kt to Kt3
13. Castles QR	Q to B sq. (f)
14. P to Kt5 !	P to KR4
15. P to Kt6 (g)	

Black.



White.

	P to B3
16. Kt to Kt3 (h)	Q to Kt2
17. Kt to R2	Castles QR

White. Schallopp.	Black. Blackburne.
18. Kt × P	QR to Kt sq.
19. Kt × P ! (i)	R × Kt
20. P to R5	P to B4
21. QR to Kt sq. (j)	Kt to Q sq.
22. Kt to B sq.	B to K sq.
23. Q to K5	R (Kt2) Kt sq
24. P to Kt7 !	R to R7
25. B × BP !	KR × P

Black.

White.

26. R × R	Q × R (k)
27. R × R	Q × Kt (ch)
28. K to B2	B to Q2
29. P to R6 (l)	Kt to B5
30. Q to K4	K to Kt sq.
31. P to R7	P to Kt5
32. Q to K sq. (m)	Kt to R6 (ch) (n)
33. P × Kt	Q to B5
34. P to R8 (Q) (o)	

Notes.

(a) Every move that developes a piece, without giving the opponent a good chance of doing the same, is a distinct gain of time. Formerly White in this Opening played at an early stage P × QP. This liberated Black's QB, and gave him quite as much freedom of action as White had. 4. B to KKt5 has mostly been played of late; but, except that it occasionally enables White to surprise Black on the K's side if he is injudicious enough to Castle too early, nothing much comes of that move.

(b) We cannot approve of this capture. In the first instance, White establishes a piece on K4, from whence it can only be effectually displaced by P to KB4 on the part of Black, which move, however, would leave his KP weak. Then again, by playing P × P Black secures White's position, and removes a weakness in White's game, which ought to help Black in his development. For instance, by leaving the P en prise, and playing B to Kt5, Black at once threatens to win a P. He therefore compels White to do something, and thus gains time for development. If in reply to 4. B to Kt5 White plays 5. B to KKt5, the position is that of the game between Gunsberg and Mason at the Hamburg Tournament, in which the latter continued with 5. P to KR3. 6. B × Kt, Q × B. 7. P to K5, Q to K2. 8. Q to Kt4, Q to Kt4, &c.

(c) Had Black Castled, Herr Schallopp intended to proceed with 8. Kt × Kt, B × Kt. 9. P to KKt4, instituting an attack on the K's side.

(d) Not knowing how to act, Black intends to seek an opening on the Q's side in a very round-about way. All things considered, it would have been the lesser evil for Black to have chosen the following line of play :—9. Kt to Q4. 10. B to Q2, P to B4. 11. Kt to Kt3, B to B3, &c.

(e) White's attack is both energetic and original, the game throughout does not follow the conventional lines which by most players are too anxiously adhered to in match play.

(f) Black is actually driven to this resource for bringing his Q out of the way, to enable him to Castle.

(g) Every move of White is played with telling effect. If Black takes the proffered P, White would further improve his game by Kt (K4) to Kt5.

(h) Going at once for the isolated RP.

(i) It is quite refreshing to see such a splendid example of originality and enterprise in attack. White, not content to win by the P he has gained, gives up the piece to obtain two passed P's.

(j) Herr Schallopp thinks that KR to Kt sq. would have been better, for subsequently Black moved his Kt, and brought the Q to bear on the KR, thereby retarding White's advance.

(k) The game is full of interest at every step. If Black had played R × R, White could proceed with 27. B to K4, followed by P to R6 or Q × R. In any case White has several ways of winning.

(l) Threatening mate.

(m) Leaving no square for Black to retire his Q.

(n) A desperate effort to open White's game with a view to a perpetual check.

(o) The game extended another dozen moves or so, after which Blackburne had to resign, his ingenious efforts having been of no avail.

Mr. R. A. Proctor's Lecture Tour.

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Each Lecture is profusely illustrated.

Arrangements are now being made for the delivery of Lectures by Mr. Proctor from August onwards. Communications respecting terms and vacant dates should be addressed to the Manager of the Tour, Mr. JOHN STUART, Royal Concert Hall, St. Leonards-on-Sea.

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Oct. 3, 17, Malvern; Oct. 31, Marlborough College.

Nov. 4, Burnley; Nov. 9, Stafford; Nov. 12, Middlesbrough; Nov. 17, Darwen.

Dec. 7, 8, 9, Croydon; Dec. 16, 17, 18, 19, Leamington.

Jan. 12, Hull.

Feb. 3, Alexandria; Feb. 6, 20, Malvern; Feb. 10, Walsall; Feb. 15, Upper Clapton; Feb. 18, 25, London Institution.

Contents of No. 198.

NOTICES.

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AMERICANISMS

(*Alphabetically arranged*).

By Richard A. Proctor.*

Abrogans or *Abergoins* is the Western way of calling the natives or Aborigines.

Absquatulate signifies to run away. It is now less often heard than of yore, having been replaced in some degree by the word "skedaddle."

Account, "of no account" is an American way of expressing worthlessness. *No account* becomes an adjective: "no account men," Bret Harte says, meaning worthless fellows.

Admire. To wonder at. Often used with at. "I admire at that," for I wonder at that. The expression is good old English.

After night, in the middle States, means "after nightfall."

All-fired, a polite form for Hell-fired,—the meaning is not mistakable.

All to pieces, and *all to smash* signify "utterly."

Allow. To assert, affirm, or merely to express an opinion. This expression is often put by English writers in the mouths of Yankees; but as a matter of fact it is only used in the Southern and Middle States.

Along. "Get along" is used in America where in England we should say "get on."

Anan. Leatherstocking's expression. I have only heard this once,—at an eating house in Pittsburg. The expression is used in Pennsylvania.

Ante. To *ante* a sum, is to risk it. The expression belongs to a game called poker, much played by the lower class of gamblers, horse-thieves, politicians, cowboys, and the like.

Anything else, Not,—meaning "just that." If an American is asked whether some one really did such and such a thing, and he wishes to emphasise his reply, he will say, "He didn't do anything else."

Apple Brandy and *Apple Jack.* A strong liquor fermented from apple juice.

Approbate, is sometimes used in America—incorrectly, of course—for "approve."

Arkansas Toothpick. A bowie-knife, with closing blade. I have never seen an American pick his teeth with an Arkansas Toothpick; but I can believe *anything* about tooth-picking in America. The public display of such arrangements as any American finds desirable for his or her teeth must be regarded as a national institution. In England a man will endure some pain rather than pick his teeth in public. In America, scarcely anyone, man woman or child, deems it necessary to refrain. Americans rather seem to rejoice in the performance. Possibly it may be thought something to be proud of to have teeth left to pick,—after much eating of hot biscuits and hot cakes. Or it may be regarded as an expression of independence. If so, America, thus judged, must be regarded as *very* free—and easy.

Around. "To be around" is used in America for "to be near" or "by." Thus a preacher in America spoke of Mary as "standing *around* the cross."

As, for "that." "I don't know as I shall go there," &c. "Only heard among the illiterate" says Bartlett; but I imagine that nine out of ten whom I have heard use this ungrammatical expression would be offended if they were described as illiterate. I have heard college professors use it freely.

At is sometimes used for "in," as "at the north" for "in the north."

At that, an odd expression used to intensify something already said, as "He is a Methodist and a hypocrite *at that*;" "he has an ugly wife and a shrew at that." Probably an abbreviation of "added to that."

Awful, used for "very," is purely American, though *awful*, used wrongly as to meaning but rightly as to grammar, is now common enough in England. In the Eastern and Middle States one often hears "awful handsome," "awful hungry," and so on.

Ax, To (for to ask), is a Yankee relic of a very old English word, still used in many parts of England.

Back of is used for "behind"; "you'll find the stick back of that box."

Back Down. To "back down" is to yield.

Back Out, To. To retreat.

Back track. "To take the back track," is to retreat.

Backwoods, the woods behind or "back" of cleared land.

Bad lands. Waste lands unfit for any sort of agriculture, and hard to travel through. The French settlers called this *Mauvaises terres*, a name still remaining in the form "Movey star."

Bad. Constantly used for the adverb "ill" or for "badly." I feel bad, is not in America an admission of moral depravity, but means simply I don't feel well. So, "I feel good" is not Pharisaic, but means I am well and happy. "Drink that wine, it will make you feel good," would mean that the drinker will feel jolly after his draught. Where something nice, though (conventionally perhaps) naughty is referred to, the expression "it will make you feel good" has a singularly odd sound in English ears. See *Chemiloon* (the reference is all right, perplexed reader).

Baggage, is used in America where we say "luggage." The word "baggage" in England has often another meaning. "To say that a man had a little baggage" with him might be misunderstood in England. A story

* I have taken as my chief but by no means my sole authority Bartlett's "Dictionary of Americanisms." I should be obliged to any correspondents who may note omissions or corrections.

is told of an English wife in America being told that her husband had arrived with "a little baggage": She went to look for that little baggage with a potato-masher.

Baggage-smasher, the name very appropriately given to the persons who move baggage to and from cars, &c.

Balance, the rest. "Peter and Andrew, with the balance of the twelve, stood around."

Bang-up. First-rate.

Bankit. I heard this expression once only, in New Orleans, for side-walk. (Fr. *banquette*.)

Bay, The Bay State, is Massachusetts. "Let the grand old Bay State proudly," said Lowell, "put the trumpet to her lips," &c., saying "you go one way we go t'other, guess it wouldn't break our hearts,"—an early cry for Secession,—forgotten subsequently by the North. But the South maintain still that the Northern states were the first to secede from the Union, by failing to adhere to the constitution.

Bayou. The outlet of a lake.

Bear State. The State of Arkansas, so named from its more characteristic inhabitants.

Beat. As a verb, to surpass. "That beats all ever I heerd." Also to astonish, to overcome. "That beats me," means that is utterly surprising to me. But "I'm dead beat" means I'm thoroughly tired.

Beat as a noun also has two meanings. It means some thing or person surpassingly good or effective or surprising, as, "I never saw the *beat* of that." But a "beat" is also one who is thoroughly exhausted, generally in pocket. A "dead beat" is for instance a man without a cent, and not willing to earn a cent.

Bed-spread. A coverlet or counterpane.

Bee. A gathering of friends and neighbours to get through work for a person or family.

A *spelling-bee* is a gathering to test skill in spelling, and tolerably dreary such gatherings are. *Crede experto.*

Bee-line. A straight line,—where in England we should say "as the crow flies," an American would say "on a bee-line."

Being as, an elegant way of saying "since" or "because." "Being as you're a friend," would mean, since you are a friend, or considering that you are.

Beliked, for liked: probably as justifiable in reality, though not by English usage, as "beloved" for "loved."

Belongings, used sometimes for property, but occasionally as a euphemism for trousers, a "gentleman's belongings."

Bender. To "go on a bender" is to start on a frolic. An unbender would seem nearer the mark.

Best. Used as a verb, meaning to get the better of.

Betterments. Improvements. *Bettermost*, for the best.

Biddy. An Irish female servant.

Big. Used not only for "large," but for fine or excellent, as "big whisky" for whisky of first-rate quality.

Big bugs. Persons of consequence.

Big meeting. A term applied to camp-meetings, gatherings of people for religious services of the sensational or hysteric kind, a custom invented by the coloured people, but known also in the wilder parts of Ireland. Commercial persons in America find it good business, I am told, to attend these religious gatherings,—they get a holiday and credit for being more religious than those who keep away.

Biling, also *Bilin'*. A set. "I'd pizen the hull bilin' of yer, if I'd my way," I heard a woman remark to a set of somewhat noisy persons who had annoyed her.

Biscuit. A biscuit in America means what we would call a hot roll in England. Some are much smaller than our hot rolls; but they are the same in character. They are indigestible to a degree; but Americans will assure you (with face dismally contradicting their words) that hot biscuits are good and healthy food.

Bishop. A "bustle,"—article of feminine gear.

Bit. I must admit great ignorance as to the real meaning of this word. In the South, a "bit" is generally half-a-quarter, *i.e.* $12\frac{1}{2}$c., equal in value to our English sixpence; but I have known a quarter and a dime (25c. and 10c. respectively) called a "bit." I believe, however, a bit usually means $12\frac{1}{2}$c.

(To be continued.)

MYSTERIES AND MORALITIES.

By Edward Clodd.

V.

IN the York series, the eighth and ninth pageants, in the Towneley and Chester, the third pageant, and in the Coventry, the fourth pageant, dramatise the building of the Ark and the Flood.

In the *Processus Noe cum filiis*,* the play opens with a long prayer by Noah, in which he recites the history of the world. God replies, repenting that he has made man, and, declaring his intention to drown the world, bids Noah build the ark and "stuf it with vitaylle." Noah tells the Deity, *sub rosa*, how his wife, like Mrs. Pepys, hath a temper of her own:—

> My wife wille I frast (ask) what she wille say,
> And I am agast that we get som fray
> Betwixt us both;
> For she is fulle tethde (ill-tempered)
> For litille oft angre,
> If any thyng wrang be
> Soyne (soon) is she wroth.

When Noah goes home to tell his wife this, she jeers him about his crochets, and says that he ought to be clothed in "Stafford blew," because he is always croaking.

> For I dar be thi borow (surety)
> From even unto morow
> Thou spekes ever of sorow,
> God send the onys (once) thi fille!
> We women may wary (curse) alle ille husbandes;
> I have oone, bi Mary! that lowsyd me of my bandes;
> If he teyn (grieve) I must tary how so ever its standes,
> With seymland (dissembling) fulle sory, wryngand both my hands
> For drede.
> *Noe.* We! hold thy tong, Ram-skyt, or I shalle the stille.
> *Uxor.* By my thryft, if thou smyte, I shalle turne the nutille.
> *Noe.* We shalle assay as lyte (quick); have at the Gille,
> Apon the bone shal it byte.†

A short fight ensues, in which the wife gets the worst of it, and then Noah begins his task "in nomine Patris, et Filii, et Spiritûs Sancti, Amen," but none the less grumbling about his stiff back and aching bones. When the ark, which has been finished "in nomine Patris, et Filii, et Spiritûs Sancti,"‡ is ready, the wife refuses to enter.

> Sir, for Jack nor for Gille wille I turne my face
> Tille I have on this hill spon a space
> On my rok (distaff);
> Welle were he myght get me.
> Now wille I donne set me,
> Yit reede I no man let me,
> For drede of a knok.

* *Towneley Mysteries*, pp. 20–34. The term *processus* was applied to these plays on account of their exhibition in connection with the Corpus Christi procession.

† *Towneley Mysteries*, p. 25. ‡ *Ibid.*, p. 26.

Noe. Behold to the heven the cateractes alle,
That ar open fulle even, grete and smalle,
And the planettes seven left has thare stalle (place),
Thise thoners and levyn (thunders and lightnings) downe gar falle;
Therfor, wife, have done, cem into ship fast.
Uxor. Yei, Nee, go cloute thi shone, the better wille thai last.

The sons' wives seek to persuade her, but in vain, and a second fight ensues, with the result that Noah groans

My bak is nere in two;

And his wife

And I am bet so blo.*

After which the termagant yields, and they enter the ark.

In the York play, Noah's wife is equally obstinate, flatly refusing to obey the message which he sends through his sons. "Telle him," she says, "I wol come no narre." When he himself would persuade her—

Come hedir faste, dame, I thee praye,

She answers

Trowes thou that I wol leve the harde lande
And tourne up here on toure deraye? (disorder)†

and, scolding him for not telling her sooner, gives him "a clowte," declaring she will enter the ark only on her "commodrys (gossips) and cosynes" coming with her, but in the end yields.

In the Coventry Series she is obedient and helpful, "a preacher of righteousness," but in the Chester she is the troublesome shrew of the York and Towneley variants.

After the patriarch and his sons have built the ark and caulked and "pyched" it, Noah adjures his wife by "Sante John" and in "Gode's name" to come in, but she answers—

Yea, sir, set up your sail,
And row forth with evil hail,
For withouten fail
I will not out of this town:
But I have my gossips every echone (one),
One foot further I will not gone;
They shall not droune, by Saint John,
An I may save their life!
They loven me full well, by Christ!
But thou let them into thy chest,
Else row, row where thee leiste
And get thee a new wife.
Noah. Shem, son, lo! thy mother is wrawe;
By God, such another I do not knawe!
Shem. Father, I shall fetch her in, I trow,
Withouten any fail.
Mother, my father after thee send,
And bids thee unto yeinder ship wend,
Look up and see the wind,
For we ben ready to sail.
Noah's Wife. Shem, go again to him, I say;
I will not come therein to-day.
Ham. Shall we all fetch her in?
Noah. Yea, sons, in Christe blessing and mine;
I would you hied you betime,
For of this Flood I am in doubt.

As in the York play, Noah's wife refuses to go on board without her female friends, who, as her sons advance, join with her in singing the *Good Gossip's Song* ending with these lines:

Here is a potill full of Malmsee full strong,
It will reioyce both harte and tenge;
Though Noe thinke us never so longe
Here will we drinke alike.

At last the three sons force her in "whether," as Shem says to her, "thou wilt or not," and as she is pulled in, Noah says to her—

Welcome, wife, into this boat,

* *Towneley Mysteries*, pp. 28, 29, 31. † York M.P., p. 47.

Upon which she gives him a box on the ears, answering,

Have then that for thy note (noddle),

And Noah cries:

Ha! . . . ha! . . . Marry, this is hot!
It is good for to be still.*

In the only relic of the Newcastle-on-Tyne pageants, the play of "Noah's Ark," performed by the shipwrights, the devil persuades Noah's wife to give her husband a stupefying drink while he is building the ark, but an angel appears, and by his help the devil is confounded and the "ship well made."

The proverbial quarrelsomeness of Noah and his wife is illustrated in Chaucer's "Canterbury Tales," when Nicholas examines the carpenter on his knowledge of Noah's flood:—

Hast thou not herd, quod Nicholas also,
The sorwe of Noe with his felawship,
Or that he mighte get his wife to ship?
Him had be lever, I dare wel undertake,
At thilke time, than all his wether's blake,
That she had had a ship hireself alone.

In the presentment of *Abraham's Sacrifice*, the scene upon Mount Moriah loses none of its dignity and pathos at the hands of the dramatist. An exceptional feature of the Chester pageant is its opening with a comic prologue by one "Gobbel on the Green," but in the dialogue between the father and the doomed son the language is not less touching than that of either the Towneley, York, or Coventry, which last-named is much inferior to the rest.

In the Towneley, after dismissing two boys and an ass which had accompanied them "forth of towne," Abraham reaches the mountain:—

Lo, my son, here is the place.
Isaac. Wod and fyere ar in my hend;
Telle me now, if ye have space,
Where is the beest that shuld be brend (burnt).
Abraham. Now, son, I may no longer layn (conceal),
Sich wille is into myne hart went;
Then was ever to me fulle bayn (ready)
Ever to fulfille myne entent.
Bot certanly thou must be slayn,
And it may be as I have ment.
Isaac. I am hevy and nothyng fayn (without joy)
Thus hastely that shalle be shent (destroyed).
A. Isaac!
I. Sir?
A. Com heder, bid I;
Thou shalle be dede what so ever betide.
I. A, fader, mercy! mercy!
A. That, I say, may not be denyde;
Take thi dede therefor mekely.
I. A, good sir, abide;
Fader!
A. What, son?
I. To do youre wille I am redy,
Where so ever ye go or ride,
If I may oght overtake youre wille,
Syn I have trespast I wold be bet.
* * * * * *
When I am dede, and closed in clay,
Who shalle then be youre son?
A. A, Lord, that I shuld abide this day.
I. Sir, who shalle do that I was won (went)?
A. Speke no siche wordes, son, I the pray.
I. Shalle ye me slo?
A. I trow I mon;
Lyg stille, I smyte.
I. Sir, let me say.

* That some artistic *mise en scène* was attempted is shown in the following stage directions:—"Then Noy shall goe into the Arke with all his famylye, his wife excepte: the Arke must be borded rounde about, and on the bordes all the beastes and fowles here after rehearsed must be painted, that these wordes may agree with the pictures."

A.	Now, my dere child, thou may not shon.
I.	The shynyng of youre bright blayde
	It gars me quake for ferd to dee.
A.	Therefor groflynges * thou shalle be layde,
	Then when I stryke thou shalle not se.
I.	What have I done, fader, what have I saide?
A.	Truly, no kyns ille to me.
I.	And thus gyltles shalle be arayde.
A.	Now, good son, let siche wordes be.
I.	I luf you ay.
A.	So do I thee.
I.	Fader!
A.	What, son?
I.	Let now be seyn
	For my moder luf.
A.	Let be, let be!
	It wille not help that thou wold meyn (complain);
	Bot ly stylle tille I com to the,
	I mys a lytylle thyng I weyn.

Then making pretence of having lost something as excuse for delay, and to hide his tears, Abraham says:—

He spekes so rufully to me
That water shotes in both myn eeyn.
I were lever than all warldly wyn
That I had for hym onys unkynde;
But no defawt I faund hym in;
I wold be dede for hym or pynde,
To slo hym thus I thynk grete syn,
What shal I to hys moder say?
For wher is he tyte wille she spyr.

In modern English: What water shoots into both mine eyes! I should have been more glad than of all worldly gain, if I had found him once unkind; but I never found him in fault. I would willingly die or endure suffering for him: to slay him thus I think a great sin. What can I tell his mother when she quickly asks, where is he? Then the angel, with the "beest God sendes to thyn offerand," arrests the father's hand, but Abraham will not talk with him till he has unbound and kissed his son.

The corresponding scene in the York pageant is thus pourtrayed. When Isaac bids his father take the sword, since his "flesshe waxis faynte for ferde," Abraham replies:—

	Nay, nay, sone, nay, I the be-hete,
	That do I noght, with-outen were,
	Thy wordis makis me my wangges (cheeks) to wete,
	And chaunges, childe, ful often my cheere.
	Ther-fore lye downe, hande and feete,
	Nowe may thou witte thyn oure is nere.
Isaac.	A! dere fadir, lyff is full swete,
	The drede of dede dose all my dere.
	As I am here youre sone,
	To god I take me till,
	Nowe am I laide here bone, (ready)
	Do with me what ye will.
	For fadir, I aske no more respete,
	Bot here a worde what I wolde mene,
	I beseke you or that ye smyte,
	Lay doune this kyrcheffe on myn eghne.
	Than may youre offerand be parfite,
	If ye wille wirke thus as I wene,
	And here to god my saule I wite,
	And all my body to brenne bydene (burn forthwith).
	Now fadir be noght myssyng,
	But smyte fast as ye may.
Abraham.	Fare-wele, in goddis dere blissyng,
	And myn, for euer and ay.
	That pereles prince I praye
	Myn offerand here till haue it,
	My sacryfice this day,
	I praye the Lorde ressayne it.
Angel.	Abraham! Abraham!
Abraham.	Lo! here I wys.
Angel.	Abraham, abyde, and halde the stille.
	Sla noght thy sone, do hym no mysse,
	Take here a schepe thy offerand tyll, [*a sheep comes in*]
	Is sente the fro the Kyng of blisse.*

* With the face downwards.

To this pageant there succeeds in varying arrangement the *Processus Prophetarum*, in which Moses recites the commandments, while David, Daniel, the Sybil, &c., deliver the Messianic prophecies; the Towneley series containing an additional play on the like subject, entitled *Cæsar Augustus*. The *Pharao* of the Towneley series, and the *Departure of Israelites* in the York series, are nearly identical, and deal with the ten plagues, the deliverance of the Hebrews, and the drowning of the Egyptian pursuers, the last words of Pharaoh being—

Heyf up youre hertes unto Mahowne,
He wille be nere us in oure nede;
Help, the ragged dwylle, we drowne,
Now mon we dy for alle oure dede.

This pageant is absent both from the Coventry and Chester series, the plays based on the Old Testament in the former ending with *The Prophets*, and in the latter with *De Mose et Rege Balaak et Balaam.*

Of the York plays, 11 out of 48; of the Towneley, 8 out of 32; of the Coventry, 7 out of 42; of the Chester, 5 out of 25; are drawn from Old Testament narratives. That the five pageants occupied the first day's exhibition at Chester is shown by the closing lines of the play on Balaam:—

Nowe, worthy sires, bouth greate and small,
You have we shewed this stage before;
And yf yt be pleasinge to you all,
To morrowe nexte you shall have more.

* York Mystery Plays, pp. 64, 65.

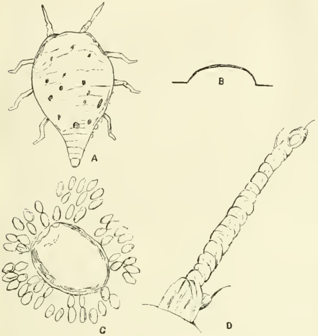
PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

In the second week in August it was noticed that many oak leaves in a clipped hedge were full of yellowish-green spots. The cause of the appearance was seen immediately on looking at their under surface, where a number of minute, yellow, soft-looking objects were discovered. A hand-magnifier showed that they were very small insects in company with eggs arranged in concentric and nearly circular curves. Some of the creatures were completely surrounded with their eggs, which had the aspect of slender ovals of clear glass; others had only deposited a few eggs, and some of these were brought to the house without disturbing their position on the leaf, and placed under the microscope, with a $1\frac{1}{2}$ inch power for a general view, and subsequently 1 inch, and $\frac{1}{2}$ inch, and $\frac{1}{6}$ inch, for observation of mere details. The first appearance of one of the egg-layers was that of a shapeless little mass of yellow jelly, destitute of limbs, and variegated with a few red spots. This state of things lasted for more than an hour, when some jerkish movements began. The antennæ, which had been folded close up to the creature, made some feeble motions, and some legs were protruded. It was, however, at the tail-end that most energy was displayed, and after a little while the Phylloxera, for such it was, assumed an appearance like Fig. A. The tail-end was employed as a feeler to ascertain the position of the last egg that had been laid. This information determined the creature's selection of the spot on which to deposit her next egg, which was guided to its place by a pair of blunt, pear-shaped ovipositors.

More eggs were laid in slow succession, and then came

a long pause, during which the performer changed her shape several times. In the A condition, the curves of her body were approximately circular, and regular from side to side. At one time a flat margin was seen all round, and a bump in the middle. B shows this form in section, and it is something like the figure given by Mr. Buckton in his valuable work. Fig. C represents the appearance of a quiescent female surrounded by more than fifty eggs. A finally got back into this lumpish shape.



In a day or two the egg-layers became scarce, and then vanished altogether, but scores of larvæ and pupæ continued their depredations on the hedge. Many oak-leaves were spotted all over with orange-red instead of the fresh greeny yellow first noticed. These exhibited no egg-layers, and the change of tint was the result of more complete destruction of the chlorophyl and cell tissue. A winged form was common on these leaves.

The writer has oak in various hedges made on the Sussex plan, but only one hedge was conspicuously attacked by the Phylloxera, and the large oaks, so far as could be seen, were not affected. The eggs, when first laid, were smooth and glossy, but after a little while they become pitted. None hatched while under several hours' observation, and when, a few days later, more specimens were wanted, none could be found. Buckton gives the size of the Queen Mother as $0{\cdot}030 \times 0{\cdot}012$, and describes her as very small and flask-shaped, which corresponds with A turned upside down. This form, however, was only exhibited in my specimens when the egg-laying was in process.

The antennæ are three-jointed. Fig. D shows two joints, the terminal one having a curious oval depression near the top, bounded by a raised wall. This does not exactly correspond with the description in Mr. Buckton's book, which, in describing the genus Phylloxera, says: "Antennæ three-jointed . . . The third joint much the longest, roughly imbricated, with a circular tubercle near its base, and a longer, somewhat inconspicuous, tubercle, towards its apex." The specimens I found had little projective "tubercles," from which a hair sprang, at the base, but the upper oval was certainly a walled depression, and appeared so with half-inch, sixth, and one-twelfth objectives. Two minute projections carry the hairs at the tip. The legs are short, with two claws and minute pulvilli. The visibility of the oval wall and depression depends upon its position under the microscope. A full-faced view is plain enough; a profile one at best looks like a very slight notch.

These Phylloxeræ are, according to Buckton, "in a qualified sense, exclusively oviparous, for the true ovum applies only in strictness to the produce of the perfect sexes." The pseudo-eggs laid here in August are thus to be regarded as only more backward stages of the least advanced young excluded by the aphides with their limbs still folded up.

The ringed forms, now on the oak leaves, are imagoes—the Latin plural looks awkward, and the word may, I hope, be treated as English.

"Late in the autumn," says Mr. Buckton, "the second brood of a late (winged) female occur, and these contain eggs of different sizes, disclosing the true males and their females." The Queen, or founder of a new brood, "is the produce of the single egg laid by the true female." The various forms are depicted in Mr. Buckton's work. I do not know whether my specimens belong to the species *punctata*, as they do not exactly correspond with his figures.

It is satisfactory that hitherto the English representatives of the genus Phylloxera have not been guilty of any serious injury like their relatives on the continent, which played such havoc in the vineyards. Speckling some leaves of our oaks is very different from the underground assaults on the vine-roots, against which no complete defence has yet been found. The mouth of Phylloxera is like that of the aphis.

The possessor of a microscope, unless very busy with some special study, should always be on the look-out as an observer of what is going on in minute life. Something fresh and interesting is sure to be the reward. For example, a glance at a mushroom-bed made in a frame and kept dark with a cover, showed some small odd-looking brown bodies moving clumsily about as soon as the light was allowed to enter. They proved to be small green flies (dipters)—whose name I do not know—and they were so thickly covered with mites that they could scarcely waddle, and not a bit of their skin could be seen. Two sorts of mites were visible with a handglass—one a Gamasid, like those common on bees and beetles, brown, with hard skins, and about as big as the heads of minikin pins. These were in clusters of half-dozen or more, and, beside them, were swarms of a smaller transparent and very lively mite. These last had their foremost legs longer and finer than the others, which is not uncommon. Watching their movements under an inch and a-half power sufficed to show that the motion of their legs differed somewhat from that of the others. They acted as pioneers, and rapidly changed the direction of motion, when, as often happened, they touched the legs of fellow-travellers. The antennæ being short, these legs did some of their work, as well as that of locomotion.

For permanent preservation, the Phylloxera and mites were mounted in balsam. A small ring of stout paper was gummed on to a glass-slide, and a minute quantity of Canada balsam put in the middle. To this the insects were cautiously transferred, and more balsam added to fill up the shallow cavity, and a cover-glass put on. This treatment sufficed for a small bit of oak-leaf with the Queen Mother and her eggs, as shown

in A. For quick treatment of dissected parts, such as antennæ or mouth-organs, a drop of saturated solution of potassic acetate answers, with a cover kept in its place by a ring of gummed paper.

FINDING THE WAY AT SEA.

By Richard A. Proctor.

(*Continued from p.* 150.)

UNFORTUNATELY, the longitude is not determined so readily. The very circumstance which makes the determination of the latitude so simple introduces the great difficulty which exists in finding the longitude. I have said that all places in the same latitude have the same celestial scenery; and precisely for this reason it is difficult to distinguish one such place from another, that is, to find on what part of its particular latitude-circle any place may lie.

If we consider, however, how longitude is measured, and what it really means, we shall readily see where a solution of the difficulty is to be sought. The latitude of a station means how far towards either pole the station is; its longitude means how far *round*, from some fixed longitude, the station is. But it is by turning round on her axis that the earth causes the changes which we call day and night; and therefore these must happen at different times in places at different distances round. For example, it is clear that if it is noon at one station it must be midnight at a station half-way round from the former. And if any one at one station could telegraph to a person at another, "It is exactly noon here," while this latter person knew from his clock or watch, that it was exactly midnight where *he* was, then he would know that he was half-way round exactly. He would, in fact, know his longitude from the other station. And so with smaller differences. The earth turns we know from west to east,—that is, a place lying due west of another is so carried as presently to occupy the place which its easterly neighbour had before occupied, while this last place has gone farther east yet. Let us suppose an hour is the time required to carry a westerly station to the position which had been occupied by a station to the east of it. Then manifestly every celestial phenomenon depending on the earth's turning will occur an hour later at the westerly station. Sunrise and sunset are phenomena of this kind. If I telegraph to a friend at some station far to the west, but in the same latitude, "The sun is rising here," and he finds that he has to wait exactly an hour before the sun rises there, then he knows that he is one hour west of me in longitude, a most inexact yet very convenient and unmistakable way of speaking. As there are twenty-four hours in the day, while a complete circle running through my station and his (and everywhere in the same latitude) is supposed to be divided into 360 degs., he is 15 degs. (a 24th part of 360) west of me; and if my station is Greenwich, he is in what we, in England, call 15 degs. west longitude.*

But what is true of sunrise and sunset in the same latitudes and in different longitudes, is true of noon whatever the latitude may be. And, of course, it is true of the southing of any known star. Only, unfortunately, one cannot tell the exact instant when either the sun or a star is due south or at its highest above the horizon. Still, speaking generally, and for the moment limiting our attention to noon, every station towards the west has noon later, while every station towards the east has noon earlier, than Greenwich (or whatever reference-station is employed).

I shall presently return to the question how the longitude is to be determined with sufficient exactness for safety in sea voyages. But I may digress here to note what happens in sea voyages where the longitude changes largely. If a voyage is made towards the west, as from England to America, it is manifest that a watch set to Greenwich time will be in advance of the local time as the ship proceeds westwards, and will be more and more in advance the farther the ship travels in that direction. For instance, suppose a watch shows Greenwich time; then when it is noon at Greenwich the watch will point to twelve, but it will be an hour before noon at a place 15° west of Greenwich, two hours before noon at a place 30° west, and so on—that is, the watch will point to twelve when it is only eleven o'clock, ten o'clock, and so on, of local time. On arrival at New York, the traveller would find that his watch was nearly five hours fast. Of course, the reverse happens in a voyage towards the east. For instance, a watch set to New York time would be found to be nearly five hours slow, for Greenwich time, when the traveller arrived in England.

In the following passage these effects are humorously illustrated by Mark Twain:—

"Young Mr. Blucher, who is from the Far West, and on his first voyage" (from New York to Europe) "was a good deal worried by the constantly changing 'ship-time.' He was proud of his new watch at first, and used to drag it out promptly when eight bells struck at noon, but he came to look after a while as if he were losing confidence in it. Seven days out from New York he came on deck, and said with great decision, 'This thing's a swindle!' 'What's a swindle?' 'Why, this watch. I bought her out in Illinois—gave 150 dols. for her, and I thought she was good. And, by George, she *is* good on shore, but somehow she don't keep up her lick here on the water—gets sea-sick, maybe. She skips; she runs along regular enough till half-past eleven, and then all of a sudden she lets down. I've set that old regulator up faster and faster, till I've shoved it clean round, but it don't do any good; she just distances every watch in the ship,* and clatters along in a way that's astonishing till it's noon, but them "eight bells" always gets in about ten minutes ahead of her any way. I don't know what to do with her now. She's doing all she can,—she's going her best gait, but it won't save her. Now, don't you know there ain't a watch in the ship that's making better time than she is; but what does it signify? When you hear them "eight bells," you'll find her just ten minutes short of her score—sure.' The ship was gaining a full hour every three days, and this fellow was trying to make his watch go fast enough to keep up to her. But, as he had said, he had pushed the regulator up as far as it would go, and the watch was 'on its best gait,' and so nothing was left him but to fold his hands and see the ship beat the race. We sent him to the captain, and he explained to him the mystery of 'ship

* In this case, he is "at sea" (which, I trust, will not be the case with the reader), and, we may suppose, connected with Greenwich by a submarine telegraph in course of being laid. In fact, the position of the *Great Eastern*, throughout her cable-laying journeys, was determined by a method analogous to that sketched above.

* Because *set* to go "fast." Of course, the other watches on board would be left to go at their usual rate, and simply put forward at noon each day by so many minutes as corresponded to the run eastwards since the preceding noon.

time' and set his troubled mind at rest." "This young man," proceeds Mr. Clemens, *apropos des bottes*, "had asked a great many questions about sea-sickness before we left, and wanted to know what its characteristics were, and how he was to tell when he had it. He found out."

I cannot leave Mark Twain's narrative, however, without gently criticising a passage in which he has allowed his imagination to invent effects of longitude which assuredly were never perceived in any voyage since the ship *Argo* set out after the Golden Fleece. "We had the phenomenon of a full moon," he says, "located just in the same spot in the heavens, at the same hour every night. The reason of this singular conduct on the part of the moon did not occur to us at first, but it did afterwards, when we reflected that we were gaining about twenty minutes every day, because we were going east so fast; we gained just about enough every day to keep along with the moon. It was becoming an old moon to the friends we had left behind us, but to us Joshuas it stood still in the same place, and remained always the same." Oh, Mr. Clemens, Mr. Clemens! In a work of imagination (as the "Innocents Abroad" must, I suppose, be to a great extent considered), a mistake such as that here made is perhaps not a very serious matter; but suppose some unfortunate compiler of astronomical works should happen to remember this passage, and to state (as a compiler would be tolerably sure to do, unless he had a mathematical friend at his elbow), that by voyaging eastwards at such and such a rate, a traveller can always have the moon "full" at night, in what an unpleasant predicament would the mistake have placed him. Such things happen, unfortunately; nay, I have even seen a work, in which precisely such mistakes have been made, in use positively as a text-book for examinations. On this account, our fiction writers must be careful in introducing science details, lest peradventure science teachers (save the mark!) be led astray.

It need scarcely be said that no amount of eastwardly voyaging would cause the moon to remain always "full" as seen by the voyager. The moon's phase is the same from whatever part of the earth she may be seen, and she will become "new," that is, pass between the earth and the sun, no matter what voyages may be undertaken by the inhabitants of the earth. Mr. Clemens has confounded the monthly motion of the moon with her daily motion. A traveller who could only go fast enough eastwards might keep the moon always due south. To do this he would have to travel completely round the earth in a day and (roughly) about 50½ minutes. If he continued this for a whole month, the moon would never leave the southern heavens; but she would not continue "full." In fact we see that the hour of the day (local time) would be continually changing,—since the traveller would not go round once in twenty-four hours (which would be following the sun, and would cause the hour of the day to remain always the same) but in twenty-four hours and the best part of another hour; so that the day would seem to pass on, though very slowly, lasting a lunar month instead of a common day.

(*To be continued.*)

Liabilities of Telephone Companies.—According to exchanges, the telephone companies in the States may be held liable for injuries to passengers by the fall of their wires in the public street. In a recent case, in which this was decided, the wires gave way in consequence of the weight of the ice produced by water thrown upon them by a city fire department whilst extinguishing a fire.

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

THE ROCKS OF THE LICKEY.

(*Continued from page 135.*)

RETRACING our steps to the Lickey ridge—and here the New Rose and Crown offers the only chance of refreshment for some distance round—we continue our south-easterly walk over the camel-backed hills which succeed one another in that direction. To the east the Triassic sandstones and clays form a plain extending to Birmingham, while on the west lies a narrow valley above which rises the Bromsgrove Lickey, a parallel chain of hills to that upon which we are walking, but of much greater altitude—the highest point of the "Lower Lickey" (upon which we are now, in imagination, standing) being about 500 feet above sea-level, while the height of the "Bromsgrove Lickey" is about 900 feet. At one spot on the road where a little lane branches off to the right, another patch of the breccia at the base of the Llandovery sandstone is seen, showing that this rock once extended right over the hills, although it has now been almost entirely denuded off them. The quartzite supports but a scanty vegetation, conspicuous amongst which are the bilberry bushes, which in the autumn furnish an abundant harvest of blue berries to many busy gatherers. Rabbits flit among the ferns, watched by a kite which hovers overhead, and the whole scene causes us to envy the occupiers of the trim villas which are springing up here and there round the Lickey, but to hope that the ridge itself—too steep and bare for cultivation—will long be preserved as a free and "happy hunting-ground" for the lover of nature.

Turning to the left, when we arrive at a steep, almost precipitous descent, we once more reach the main road, at the eastern foot of the hills at Rednal. Continuing southwards, we note a quarry in which the quartzite is grandly bent and contorted, showing that we are here close to the line of fault which runs along this edge of the ridge. A mile more and we reach Kendal End, where a divergence to the right, past the farm-house, should be made to examine a patch of *Wenlock limestone*, which must owe its position here to a system of faults. It lies in an old quarry, now planted over with trees [see Map (3), *ante*, p. 134]. The high road now must be regained, and in ten minutes we reach Barnt Green House, close to the railway-bridge, the residence of Mr. Thompson, agent to Lord Windsor, who owns much land about here. We have to thank this gentleman for the permission—which would doubtless be accorded to any respectable visitor—to examine the interesting rocks exposed along the brook-course which traverses the grounds [see Map (4)]. In many districts the sections of the strata exposed by running streams afford the only plain indications of the succession of the rocks, and in a new district it is always well to first walk up the available brooks and rivers. Pursuing this plan, we find forming the bed and banks of the purling brook a singular dark-grey rock, which readily breaks into rhomboidal blocks, being traversed by many joints. Sometimes this rock is of a red or yellowish colour, and it is frequently more or less spotted. It has an earthy look, and altogether reminds one of a compacted volcanic ash, such as forms many square miles of the country round Vesuvius. But if active volcanoes once existed in this corner of Worcestershire, and erupted the mass of ashes which now, hardened into solid rock, lies beneath

our feet, it must have been at a very early geological period, for these old volcanic ashes can be proved to *underlie*, and therefore to be older than, all the other rocks here visible. The quartzite, we know, is of great antiquity, but these rocks at Barnt Green must be still older, for they underlie the quartzite. Now, at Nuneaton and at the Wrekin, volcanic rocks are also found beneath the quartzite. Moreover, in Wales, in Charnwood Forest, and elsewhere, a great mass of bedded volcanic rocks—ashes, lavas, &c.—are found to underlie the Cambrian strata, and are assigned to a Pre-Cambrian period, which includes the oldest stratified rocks of which we have any knowledge.

Thus it seems that, peeping out in this little corner of the Lickey at Barnt Green, we have a representative of the earliest-formed series of rocks known upon the globe—the great Pre-Cambrian Formation—which are everywhere unfossiliferous. Above them, and constituting the ridge called the Lower Lickey, comes the Cambrian quartzite, whose thickness is probably between 300 and 400 feet. Resting unconformably on the quartzite are Upper Silurian strata; above them come the coal-measures, which form the extreme southerly termination of the South Staffordshire coal-field; next we get Permian rocks, crowded with fragments of the older beds beneath; and, above all, the Trias, or New Red Sandstone, in whose Bunter pebble-bed we see a great conglomerate of quartzite pebbles, many of which were undoubtedly derived from the ridge of the Lickey, or its extension.

For although this quartzite of the Lickey is now only exposed as a tiny range of hills, yet in carboniferous times it formed part of a land-barrier which extended across central England from the hills of Charnwood to the Malverns. Of this old land, the Hartshill range, Dosthill, the Lickey, the Silurian bosses at Dudley Castle and the Wren's Nest, the Wrekin range, and the Longmynd hills of Shropshire, are isolated fragments which owe their present position to the combined action of the volcanic forces by which they have been upheaved, and the forces of denudation by which they have been laid bare. But various deep borings—more especially those in Leicestershire, and between Leicester and London—have revealed the presence of a continuation of these old rocks beneath the surface at no great depth, and they form the floor of all the country between the Thames Valley on the south, and a curved line joining the Malvern with the Charnwood hills on the north.

It is an interesting task to search in the newer strata—the Permians and the Trias—for the relics of this old land, which reared its head proudly above the waters in which they were deposited. In Bangham-lane, leading to Northfield, two or three miles north of the Lickey, there is a section of Permian breccias from which quite a suite of Silurian fossils may be collected, showing that Silurian rocks formed the margin of the sea in which the Permian strata were laid down.

If the geologist can devote a whole day to the examination of the Lickey, he may, instead of returning from Barnt Green station, walk along the *western* side of the Lickey ridge back towards Rubery. At the northern end of the ridge several fine boulders are to be seen lying on the roadside or in the waste corners of fields. These boulders are mostly blocks of rock which have been transported from North Wales by ice during the last Glacial Period. Such blocks lie thickly, too, over the country round Northfield, where the "Great Stone Inn" takes its name from the mass of Welsh felstone which now rests near its door.

FINAL OPERATIONS FOR THE REMOVAL OF FLOOD ROCK.

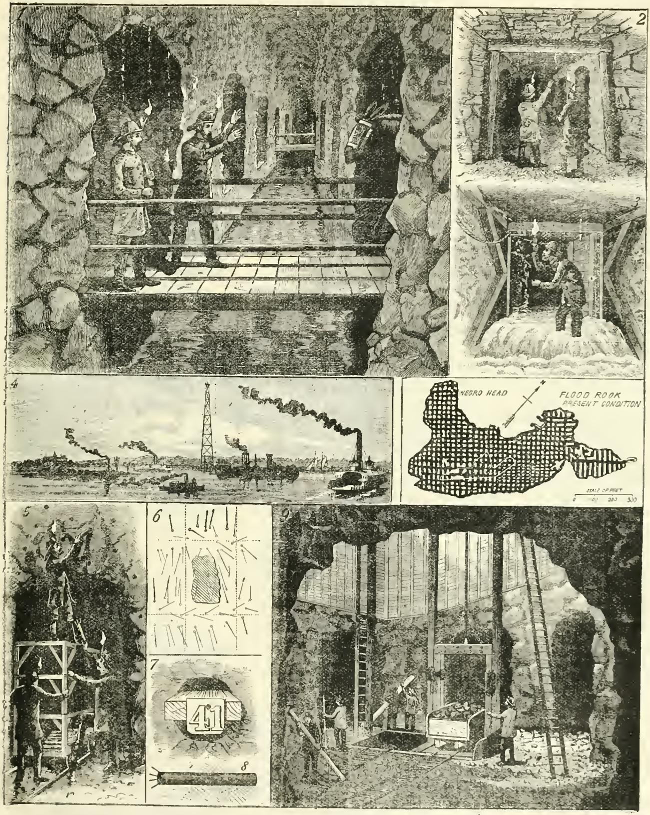
Flood Rock, a ledge of gneiss situated about one-quarter of a mile from Hallet's Point, Astoria, L.I., is one of the most formidable of the many obstructions by which all the commerce passing through Hell Gate has been menaced. This rock forms a very irregular obtuse cone, only a small portion of the apex of which comes above water. This formation and its location in the bend of the river almost in the centre of a swift current at each change of the tide make it an object of great dread to pilots. The work of removing this rock was begun in 1875, and after unnecessary and costly delays caused by the failure of Congress to appropriate sufficient money from year to year the entire excavation has been completed, all the drill-holes have been bored, and all that remains to be done is the charging of the holes with explosives, removing the plant, and dredging the broken rock after the firing. The total cost of the improvement will be about 1,000,000 dols.

The method pursued may be briefly described, the familiarity of our readers with the undertaking rendering a detailed account uncalled for. A shaft was sunk at the highest point of the rock to a depth of sixty feet below water level, and from this shaft galleries were extended parallel with and at right angles to the current. These galleries are twenty-five feet between centres, and extend under all the rock to be removed. It was not the design to remove the rock as much as possible by means of these tunnels—owing to the fact that it would be cheaper to dredge the broken rock after the explosion—which were only expected to serve as passageways honeycombing the rock and through which access could be had to all parts in order to place the powder. Absolute regularity in the spacing of the galleries could not be maintained owing to inequality in the texture and formation of the rock. The plan view in the accompanying illustrations shows the present condition of the excavation, and, being drawn to scale, it presents a good idea of the magnitude of the work.

Thus was formed an immense chamber, averaging about 10 ft. from floor to ceiling, having a stone roof averaging about 15 ft. in thickness, and supported by 467 rugged and massive columns. In this chamber, running parallel with the East River, are twenty-four galleries, the longest measuring 1,200 ft., and running at right angles to the stream are forty-six galleries, the longest of which is 625 ft. The area covered by the chamber is about nine acres. The aggregate length of the galleries is 21,670 ft.

The mining operations were not attended with unusual risk either to the men or the work; the main danger was from the flooding of the mine through the opening of a fissure, or the meeting with a rock "keyed the wrong way," which would admit the water in quantities too great to be handled by the pumps. Fissures were frequently encountered, but fortunately none of excessive size; the large holes were plugged with wood, loose filling, such as cement, being unavailable because of the great pressure of water, some 26 lb. to the square inch. To escape the drippings, and in some cases the pourings, from the roof, and to enable the visitor to walk dry-shod through the small brooks running down some of the galleries, he is, through the kindness of those in charge of the work, encased in rubber from head to foot.

The north-eastern portion of the excavation, having an area of about one acre, was through rock very irre-



gularly fissured, and as the roof approached closer to the bed of the river great care was exercised in driving the headings; in some places it was found expedient to support the roof and sides with heavy timbers, as shown in Fig. 2. In order that the caving in of any part of this section should not flood the main work a strong door (Fig. 3) was early built in the gallery connecting the two sections. Attached to the outer edges of this door is a rope, leading over a pulley in the casing and along the gallery to the shaft; the door can thus be easily and

quickly closed, should it become necessary at any time to shut off the weak portion of the work.

Thirteen thousand two hundred and eighty-six holes have been drilled in the columns and roof, the holes being 3 in. in diameter and having an average depth of 9 ft.; these holes, if placed end to end, would reach over 22 miles. During the progress of the work an accurate plan was kept, showing the location and number (Fig. 7) of each hole, together with its inclination and depth. Fig. 6 shows this hole plan for one column—the shaded portion—and the adjoining galleries, the centres of which are represented by the dotted lines. The holes in the columns are about 5 ft. apart, and extend upward at an angle of about 45 deg.; the holes in the roof are about 4 ft. apart, and are at an angle of 60 or 65 deg. No holes were drilled near the floor. Each hole will be filled partly with "rackarock" powder and partly with No. 1 dynamite. The form of the cartridge is shown in Fig. 8, the projecting wires shown at one end being intended to hold the cartridge in position in the hole. Fig. 5 shows the method of charging the holes. A small car is provided with several frames, made to fit on top of the car, and each being about the size of the car, the frames can be placed as needed, one on the top of the other, thus furnishing a platform from which the holes in the highest galleries can be reached. The track consists of two movable sections, about 15 ft. long. Should no delay occur, it is expected to complete the charging of the holes by October 1.

The next operation will be to remove all the machinery and buildings, and the top of the island down to the water's edge. Of course, much of this work can be done during the time of charging. The mine will then be flooded and the charge exploded by means of electricity.

The engraving, Fig. 1, shows the drainage ditch or deep gallery, extending across the mine a short distance north of the shaft. The longitudinal galleries cross this ditch, which at the point shown in the cut is some thirty-five feet from the floor to the roof, by wooden bridges. Extending around the southern part of the mine and along the eastern extremity is a second ditch, connecting with the first; a third ditch leads from the eastern side to the sump, just east of the main shaft (Fig. 9), where pumping-engines having a capacity of 4,000 gallons per minute are located. This plan of draining the mine by means of a ditch around the extremity was made necessary by the slope of the river bed; in order to leave sufficient rock in the roof, the galleries slope downward from the centre.

The work was planned and has been carried forward by General John Newton, Chief of Engineers, U.S.A. We are indebted to the courtesy of Lieut. G. McC. Derby, superintendent of the work, for the privilege of examining the mine, and for data.—*Scientific American*.

TRICYCLES IN 1885.

By John Browning.
(*Chairman of the London Tricycle Club.*)

A PERFECT SADDLE.

THE Tubular Buffer Tension Saddle, just brought out by Messrs. Lamplugh & Brown, completely eclipses all their former contrivances. The frame of the saddle is formed of two steel tubes, about a quarter of an inch in diameter; one straight, forming the backbone, the other curved, acting as the back of the saddle. The leather, which is stretched on these tubes, being divided, when the leather is on, the two sides are locked together by a strong hook underneath.

Whenever the tricycle has to be kept in a damp place, or left in the open air, the leather top can be removed in a single minute. Not only is a dry seat thus ensured, but it would be almost impossible for any one to ride away with the machine. For when the leather top is removed the curved tube on which the rubber-lined back of the saddle slips drops, being only held in position by the leather.

While being ridden the saddle is not a rocking saddle—that is, it is not free to turn on a hinge, but it is a *swaying* saddle, giving way a little on each side—from the back at each motion of the leg, and thus preventing the chafing which many riders suffer from so severely.

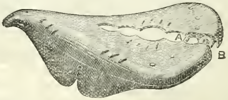


Fig. 1.

Fig. 1 is a top view of the saddle. A is the hook which clasps the two sides together underneath. It will be seen that there is such a space left between the two portions or sides of the leather that no injurious pressure can be exercised by this saddle. B is an end of one of the stout vulcanised rubber tubes to which the leather sides are attached. These act most efficiently in insulating the rider from concussion, and warrant the name of the Buffer Saddle.

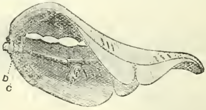


Fig. 2.

The under view of the saddle is shown in Fig. 2. In this, C and D represent a nut and a check-nut, which are used for increasing the tension when it is necessary.

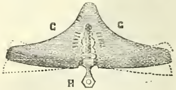


Fig. 3.

The swaying motion of the saddle is shown in Fig. 3. The peak of the saddle remains stationary, but the sides sway up and down on the pivot H by the action of the rider. I find this swaying motion such a luxury that I will never ride a fixed saddle again.

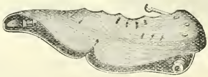


Fig. 4.

The leather top of the saddle unattached and folded is shown in Fig. 4.

The merits of this saddle are so conspicuous that I should say, while we are indebted to Starley for the tricycle, we owe the perfect saddle to Lamplugh & Brown, and I should like to see some testimonial given to them from devotees of the tricycle in acknowledgment of their ingenuity and enterprise; in which I should be glad to join.

The comfort and efficiency of a saddle depends to a considerable extent on its being set at exactly the right pitch to suit the rider. If it be too low in front the rider has a constant tendency to slip forward, and if in correcting this the front be raised too high it is not only uncomfortable, but an injurious pressure may be caused by the peak when riding.

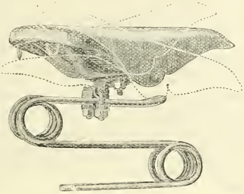


Fig. 5.

Starley's saddle-tilt, for which Lamplugh & Brown are the agents, is a contrivance which enables the rider to alter the pitch of the saddle in one or two minutes. Instead of clamping the saddle directly on to the spring in the usual manner, in which case its pitch has to be adjusted by wedges, a bar with a groove in it is clamped on to the spring, and a hollow piece which turns in it is attached to the saddle. The attachment to the saddle is placed so that it rests in the groove, and a holdfast clamp is placed astride of both, and clamped firmly down by means of two nuts clutching them together.

It is obvious that if it should be desired to change the pitch of the saddle, all that is necessary is to slacken the two nuts, rotate the saddle attachment under the stirrup, and tighten the nuts until the saddle is fixed in the new position.

The action will be seen from the engraving (Fig. 5), which shows the saddle in three positions.

When the various details of our machines have been worked out with the same thoughtful and minute attention which has been bestowed on the Buffer Saddle, we shall possess something like a perfect tricycle.

International Inventions Exhibition.—We notice that a silver medal, the highest award for geographical apparatus, has been obtained by Mr. W. Rice, of 86, Fleet-street. Mr. G. W. Bacon also receives a bronze medal for his cheap atlases.

In the Botanical Garden at Dijon there is a poplar of colossal dimensions—species not stated—to which Mr. Joly devotes a note in the *Journal de la Société Nationale d'Horticulture*. The height of this tree is 130 ft. Its circumference near the earth is 46 ft., and at 16 ft. above the earth 21 ft. Its bulk is now 1,590 cubic feet, but six years ago, before the fall of one of the largest branches, it was 1,940 ft. From some historic researches made by Dr. Lavelle, and a comparison with trees of the same species in the vicinity, it has been pretty well ascertained that this poplar is at least 500 years old. Unfortunately, it is now completely hollow up to the point whence the large branches spring. All the dead portions have been removed, and the interior has been filled in with beton.

THE FACE OF THE SKY.

From August 28 to September 11.

By "F.R.A.S."

The student will, as usual, watch the Sun on every clear day for spots and faculæ. The stars visible at night are shown in Map IX. of "The Stars in their Seasons." Minima of Algol will occur on Sept. 7, at 1h. 17m. a.m.; and on Sept. 9 at 10h. 6m. p.m. Mercury comes into inferior conjunction with the Sun at 6 p.m. on Sept. 2. He will scarcely be fairly observable until the second week in September. He travels through Leo during the next fourteen days. Venus is not a particularly interesting object, with her small gibbous disc. She is in Virgo. She may, possibly, be picked up with the naked eye, after sunset, over the western horizon. Mars, Jupiter, Uranus, and Neptune are all invisible; but Saturn is coming into view again as a morning star. He rises before midnight to-night, and a fortnight hence just before 11 p.m. He forms a triangle with ϵ and γ Geminorum ("The Stars in their Seasons," Map. II.). The Moon enters her last quarter at 5h. 14·8m. in the early morning of Sept. 2, and is new at 8h. 43·2m. p.m. on the 8th. Six occultations occur, within convenient hours for observation, during the period covered by our notes—four of them on the night of Sept. 1. Imprimis before the Moon rises, θ^1 Tauri and θ^2 Tauri, two stars each of the $4\frac{1}{2}$ magnitude, will have disappeared at the bright limb of the Moon. After she appears above the horizon, θ^1 Tauri will reappear at her dark limb at 10h. 51m., and θ^2 Tauri one minute later. The first star will reappear at an angle of 227° from the Moon's vertex, the second one 217° from the same point. Then at 11h. 1m. B.A.C. 1391, a 5th magnitude star, will disappear at the Moon's bright limb at an angle from her vertex of 117°, to reappear at her dark limb at 11h. 32m. p.m. at a vertical angle of 189°. Subsequently the 6th magnitude star, 85 Tauri, will disappear at the bright limb at 11h. 21m. at a vertical angle of 20°; reappearing 1m. after midnight at the dark limb, at an angle of 284° from the vertex of the Moon. The Moon will pass very close to Aldebaran at 1h. 40m. the next morning. On September 2 117 Tauri, a star of the sixth magnitude, will have been occulted below the horizon, but may be seen to reappear after the Moon has risen at her dark limb at 11h. 20m. p.m. 221° from her vertex. Finally, on the same night, B.A.C. 1728, another 6th magnitude star, will disappear at the bright limb of the Moon 13 minutes after midnight, at an angle of 9° from the Moon's vertex, and will reappear at her dark limb at 12h. 48m. p.m., at a vertical angle of 288°. The Moon is in Pisces all day to-day and to-morrow, but at 4 a.m. on Aug. 30 crosses into the north-west corner of Cetus. It takes her until 3 p.m. on the 30th to travel through this, and she then enters Aries. She quits Aries for Taurus at 8 p.m. on the 31st, and she proceeds on her passage through the last-named constellation until 9 a.m. on Sept. 3, when she arrives at the narrow northernmost strip of Orion. Leaving this at 8 o'clock the same evening, she emerges in Gemini, across which she is travelling until 10h. a.m. on the 5th. At the hour last named she crosses into Cancer, where she remains until 9h. 30m. p.m. on the 6th. From Cancer she passes into Leo. In her passage through Leo she descends, at 7 a.m. on the 8th, into Sextans, but three hours later emerges once again in the first-named constellation. She finally quits Leo for Virgo at 8 a.m. on the 9th, and is passing through this great constellation when our notes terminate.

Thomas Boyd, the first white man to cross the Murray River, and the last survivor of the Hume and Hovele exploring party, has died recently in Sydney, at the age of eighty-eight years, and, as we regret to learn, in great poverty.—*Athenæum.*

Another Alpine town will shortly be lighted by electricity, and following the example of Aosta, the municipality of Vazallo have recently decided to illuminate the town by electricity. The system to be adopted will be that of Cruto, and the streets will be lighted with 70 incandescent lamps. The current will be furnished by two dynamos driven by a turbine, as abundant water-power is at hand in the torrent Sesia. Besides the public lamps, the dynamos will supply from 90 to 100 lamps in private houses.

The Lighthouse Experiments.—The result of the recent experiments at the South Foreland lighthouses, in which the relative merits of oil, gas, and electricity were tested, is, in the view of the committee which carried out the investigations, to establish the fact that "for the ordinary necessities of lighthouse illumination oil is the most suitable and economical illuminant, and that for salient headlands, important land-falls, and places where a very powerful light is required, electricity offers the greatest advantages." The objection to the electric light for ordinary lighthouse purposes is that, although better than oil or gas in foggy or misty weather, it is too dazzling in fine weather.

Gossip.

By Richard A. Proctor.

Referring to part of "Hallyards' ' letter on "Magnification near the Horizon," I may remark that whether the mind does or does not unconsciously assign to the sky the form of a flattened dome is a question which cannot be disposed of quite so simply as "Hallyards" imagines. The question how much farther away the horizon seems to be than the point overhead, the sky being clear, was put by Delambre, as one depending on precise laws of optics—and the answer was "The horizon seems between three and four times as far away as the zenith." The idea of actual magnification, as an explanation, is absurd on the face of it; for if in a particular state of the air the horizontal moon, really subtending—say—30′ when not magnified, were made to subtend—say—45′, it would follow that if there were 720 horizontal moons so placed that if not magnified they would just make the circuit of the horizon, then either, as actually seen through that peculiar air they would overlap (which of course is absurd) or they would more than go round,—once and a-half round in fact—which is preposterous. (Of course it is as easy to say that the dew or fog or rain may magnify as it is to say that a body's velocity may prevent it from yielding to the attraction of gravity, or that under particular circumstances two and two might make seventeen and a-half.)

"Hallyards" may not be aware that the constellations seem to look larger near the horizon—but they cannot really look larger, or they would not all get in. The fact really is that an object can only seem to look larger than usual, when not really magnified, through some illusion which makes us imagine that the object is unusually distant.

Mr. Brothers has called my attention to an illusion which is easily tested in illustration of this. Look at some dark object on a light ground, and presently look at a white surface at the same distance: you then see the object light (and in complementary colour) and unchanged in size. But if now you look at a distant light surface, the image of the object seems to grow suddenly larger. In reality it does not increase at all in apparent size, but subtends—as of course it should—precisely the same angle, being an unchanged retinal impression, unchanged at least in extent.

The apparent magnifying of the sun, the moon, star-groups, comets, &c., near the horizon is in reality the best proof we have that the mind unconsciously assigns (as Delambre thought he had proved it ought to assign) a much greater distance to the horizon than to the zenith. That this effect varies in degree with varying states of the air shows that the mind unconsciously varies its estimate of the horizon's distance according to the state of the air. This may seem to some like arguing in a circle. But you can argue safely in a circle when you have facts all round. The fact that the moon seems to look larger near the horizon, nay much larger (insomuch that my small-disc method of measuring is by no means rough for such a problem), while in the first place we know from measurement that she does not subtend a larger angle, and in the second place from the laws of optics that she cannot be really magnified, is a good fact to argue from. So is the fact that the horizon ought to be judged farther off, some $3\frac{1}{2}$ times, than the zenith. If these facts correspond with each other that is only because, being facts, they naturally "behave as such."

My attention has been called by a correspondent who wishes to be referred to as "L. E." (I should have preferred thanking him by name) to a singular mistake in my last remarks respecting the Ruddy Eclipsed Moon. I could scarcely believe I had made such a strange mistake till I referred to my article: but there it is; and rightly understood it is a mistake well worth Miss Ballin's attention as a singular mental phenomenon.

I had explained, at p. 46, that the focus of a pencil of rays from the sun after deflection through our earth's atmosphere towards the moon lies far beyond the earth,—*not* (as many, misinterpreting the investigation of the deflection of the axes of such pencils, have fondly imagined) between the earth and the moon. Oddly enough, while of course my mind possessed the reasoning by which this point is established, I wrote at p. 135 (middle of second column) precisely as if—instead—I had known or proved, somewhere or somehow, that the focus of such deflected light-pencils lay far beyond the *sun*, which is absurd,—even taking along with this original absurdity the derived one that the focus lies hundreds of millions of miles beyond the sun. This of course was due to my setting the focus as far relatively beyond the *sun*, as it really lies beyond the earth.

Partly as a penalty for my carelessness, partly perhaps to prove that I am not ashamed to acknowledge and correct a mistake (venial vanity, I trust), and partly to show that I had correctly considered the matter originally at p. 46, I will now show how the position of the focus for a pencil of rays leaving the sun's face for the edge of the earth's disc (as seen from the moon) may be roughly determined. The exact problem would be one of some difficulty, but we can get a rough solution by the following device. The breadth of the sun during central eclipse is contracted, by the deflection of the axes of pencils, to about $2\frac{1}{2}$ miles at the edge of the earth's disc as supposed to be seen from the moon. (This supposes the part of the sun's disc farthest from the rim of the earth just lifted into view by grazing refraction, and the part nearest the earth's rim lifted into view by atmospheric layers about $2\frac{1}{2}$ miles above the sea-level.) Now this shows that the bounding pencil-axes have their convergence towards the eye of an imagined lunarian diminished to about 1-800th of what it had before been. For when the earth is away the sun's disc subtends at the moon about half a degree, corresponding to about 2,000 miles at the earth's distance, and 2,000 miles exceed $2\frac{1}{2}$ miles 800 times. It follows (since the lines of sight through the earth's atmosphere to different points on the sun follow precisely the same course as rays from those points to the eye from which the lines of sight were taken) that the divergence of a pencil from a point of the sun to our earth's atmosphere, to reach the moon, is increased on the average about 800 times. (On the average, because we have dealt with the convergence after passing through the whole depth of $2\frac{1}{2}$ miles: the eye-pupil can take in only a portion of each pencil, a small fraction of an inch broad where passing through the earth's atmosphere.) This being so, it follows that the foci of such pencils lie on the average at a distance beyond the earth (as seen from the moon) equal to about 1-800th of the sun's distance,—say

roughly, about 116,000 miles (less than I had expected to find this average). Being thus, on the average, about 355,000 miles from the moon, and on lines inclined nearly one degree to the direction of the earth's centre, it follows that these foci lie on the average about 60,000 miles from the line through the centres of the sun, earth, and moon, at the time of central eclipse.

I TRUST the readers of KNOWLEDGE will appreciate the liveliness of the last piece of Gossip. But it serves to illustrate the way in which a student of science, even when he begins to chat with the idea of treating his subject lightly, is apt to wander off into other than mere gossipy matters. Let it stand, then. Better so than as part of another article on the ruddy eclipsed moon. Let me thank L. E. again for correcting my remarkable mistake.

E. C. H. sends another letter on the "double have" question. Let me put definitely my own opinion. I do not defend such a phrase as "I should have liked to have seen him;" because they sound badly. But grammatically they are defensible. As I pointed out to "Hallyards"—who did not see it, of course—"I should have liked to see him," even in reply to the statement that "Mr. So-and-So called this morning," does not necessarily mean, "I should have liked to see him this morning when he called." It might be a convenient way of answering, in words, with a real meaning very unlike that which the words might be taken to bear—as for instance, "I should have liked to see him (in former times, but I am mightily glad to have escaped him this morning,") or "I should have liked to see him (if I did not know what an intolerable bore he is—or rogue—or as the case may chance to be.") Now there can be no doubt the second "have" definitely points to the time or occasion which had just been named.

THAT the objection to the "double haves" is merely one against their sound may be shown by sentences in which the "haves" are doubled but euphony retained. For example, "I am sorry I was not at home when A called: to have had a chat with my dear old friend, after so many years of separation, would have been a great pleasure." Or again, the double "haves" come in all right in the following answer, where the two forms of reply are distinguished:—"I am glad I was not at home: I should have liked to see him when I loved and trusted him, but to have seen him to-day, knowing him for what he is, would have been most painful to me."

"E. C. H." rightly remarks that Dr. Hodgson's detection of doubled "haves" in the writings of Macaulay, Ruskin, Landor, and other such masters, goes far to neutralise (he might have said utterly neutralises) the previous condemnation. Authors as a rule are much better judges in these matters than grammarians, sentence-analysers, *et id genus omne*. Dr. Hodgson sitting in judgment on Macaulay! Pshaw! the absurdity is too patent. Your language-dissector as a rule is a man who could not write ten pages of description or explanation (that any one could read with pleasure or profit) to save his life. He always strikes me as trying to find out why *he* can't write as well as Macaulay or any other man.

MARK TWAIN is an author; but somewhat raw in style. Albeit, I prefer not to use double "haves" in sentences where they hurt the ear. It is easy to avoid them, without confusing the sense.

I SEE from the *Daily News* of the 22nd that the readers of the American *Critic* have been extending to this country the system of balloting, by which they settled who among American worthies should form an Academy of Forty, if one were established on the model of the Académie Française. I have myself an intense dislike to all such selections—a dislike based on the sound general principle that "comparisons are odious." Why should I trouble myself to set in order of merit the poets, or historians, or novelists, or men of science, whose works delight me? Even if I do this in my own mind why should I publish my results (very likely wrong) in such sort that they may reach the ears of those whom I have thus attempted to weigh? The American Forty, for instance, does not include E. Eggleston, Prof. Young, Marion Crawford, Prof. Newcomb, Joaquin Miller, or Prof. Youmans. Why should they be thus as it were told that in the opinion of certain thousands or tens of thousands of their countrymen there are forty better men than they? Some of them may know (as *we* know of them) that the very quality and value of their work puts it above the appreciation of "the general." Still it is not necessary even to tell a man that you cannot follow him.

OF the British list it is only necessary to remark that it does not contain the names of Dr. W. B. Carpenter, Sir George Airy, Dr. B. Richardson, and others as widely known; Lord Lytton is put in, I think, under the mistaken impression that Bulwer Lytton is still alive; and I imagine that for Sir H. Thompson, the eminent physician, we should read Sir W. Thomson, whose name on account of his connection with Atlantic cabling is widely known in America.

NO man of sense stops in his work to ask how his work is valued. "What thy hand findeth to do, do it with thy might" is a sufficient rule; and it is only the childish or the senile who wonder whether they are adequately appreciated. The author who writes because he has something to say, does not wait to be patted on the back; the speaker whose heart is in his words does not wait to be applauded: why should the busy workers be invited to notice that the world or a part of the world is watching them and weighing their work,—or omits to do so?

Reviews.

SOME BOOKS ON OUR TABLE.

Dictionary of the Names of British Plants. By HENRY PUREFOY FITZGERALD. (London: Baillière, Tindall, & Cox.)—Mr. Fitzgerald may be congratulated on the production of a work which, in hackneyed phrase, really does "supply a want," and, we may add, supplies it admirably into the bargain. Into ninety pages he has compressed the names (generic and specific) of every British plant, together with their pronunciation and meaning. Considering the condition of botanical nomenclature, with its hash of dog-Latin and bastard Greek, the value of this little book to the student must be apparent at once. The very explicit directions for pronunciation will be welcomed by many whose knowledge of the plants themselves is often decidedly in advance of their ideas of how their names should be articulated. The study of this capital little book may save well-meaning people from

speaking, as we so very frequently hear them do, of clematis, gladiolus, and the like.

The Revival of British Industries. By a Candidate. (London: James Bolton. 1885.)—The object of this "Candidate's" pamphlet is to show that free trade has broken down; for the simple but sufficient reason that, like the Irishman's reciprocity, it is all on one side. British manufacturers and farmers are, our author contends, shut out of foreign markets by practically prohibitive protectionist tariffs: while manufactured goods from the countries which enact them are let into this country free. British industries are, according to "A Candidate," to be revived by putting an *ad valorem* duty of 50 per cent. on manufactured goods coming from foreign countries. Food and raw materials to be admitted free. Out of the revenue thus raised it is proposed to pay a subsidy of £1 per acre on all land in the United Kingdom which is sown with wheat. The author further suggests absolute free trade between England and her own colonies and dominions; in fact, the formation of the entire Empire into a customs league or Zollverein, all adopting the 50 per cent. duties on foreign manufactured goods. Details will be found in the pamphlet itself.

The Autobiography of a Whitehead Torpedo. By "Guns." (London: Offices of *Engineering*.)—Everyone who wishes to obtain an intelligent idea of the internal economy and mode of action of the so-called "torpedo," which is (as its votaries assert) to revolutionise marine warfare, should buy the pamphlet before us, straightway. Obviously written by a man in the Naval service who has apparently passed through both the Greenwich and the "Vernon" course, it contains by far the best popular account of the Whitehead torpedo that we have seen; and as the details of its construction and use are incorporated in the well-told narrative of its adventures, the account possesses an interest which would scarcely pertain to a mere series of diagrams and descriptions. The supposititious breaking of the blockade at Toulon and the descent of the French Fleet on Malta are uncommonly cleverly told. A very pregnant warning, to which it is earnestly to be hoped that the authorities will give heed, is uttered by "Guns" in connection with the hushing-up of accidents and miscarriages which have occurred in torpedo trials. Nothing can be more absolutely essential to the success of so delicate and ticklish a weapon than an intimate knowledge of its weaknesses and defects, by all those concerned in its use and manipulation.

Studies in Microscopical Science. Edited by Arthur C. Cole, F.R.M.S. For August, 1885. (London: Baillière, Tindall, & Cox.)—Mr. Cole this month gives us illustrations, with descriptions of the structure of Antheridia in Polytrichum, of the Gill of the Anodon, of Tuberculosis in the human lung, and of the Mouth of the Tadpole. When we add that these are all as good as ever, the practical microscopist will know what to expect.

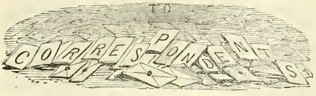
The Penny Alphabetical Time Tables, between London and all Parts of the United Kingdom and Ireland. (London: Wyman & Sons. August, 1885.)—This is a capital idea. The names of all the railway stations in the United Kingdom are given in alphabetical order, and under each one will be found a complete list of trains running both ways between the town specified and the metropolis, together with the fares, single and return. To many to whom "Bradshaw" is an inscrutable puzzle and a weariness of the flesh, this book will come (like the pens in the advertisement) "as a boon and a blessing."

Lindenblumen, and other Stories. By Rowland Grey. (London: Kegan Paul, Trench, & Co. 1885.)—"Rowland Grey's" really delightful book is made up of five stories, of which the fourth is selected as its title. Our own favourite among them is the second one, "The Doctor's Mascotte," than which nothing more charming has appeared for a long time. Graceful and interesting, their *vraisemblance* is not their least recommendation; in fact, we may say that with the (odd) exception of "Lindenblumen" itself, there is not one of these tales that contains anything which may not perfectly well have happened in real life. This volume forms a notable addition to the lighter literature of the season.

Once a Month; a Magazine for Australasia. Edited by Peter Mercer, D.D. (Melbourne and Dunedin: W. Inglis & Co.; London: Griffith, Farran, & Co.)—This magazine reaches us from the Antipodes, and is a creditable specimen of colonial literary work. Fiction, biography, travel, poetry, domestic medicine, gardening, science (a capital short article on Saturn, by Mr. Ellery), art, literature, chess, &c., make up a fairly readable number.

We have also on our table *The Lost Voice* (a song on the Ammoniaphone), *Guide to the Loan Collection of Musical Instruments, &c., Society, Bradstreet's, The Tricyclist, Wheeling, The Sidereal Messenger, The American Naturalist, Ciel et Terre* (with a conspicuous absence of *Ciel*), *The American Druggist,* and *The Country Brewer's Gazette.*

Rather more than a year ago the American journal, the *Critic,* asked for the opinions of its subscribers as to the forty Americans who, in the event of the establishment of an American Academy, after the model of the Académie Française, would be first entitled to become members of it. After the voting papers had been carefully sorted, it was found that the following names had received enough suffrages to qualify them for admission to the ranks of the Immortals: O. W. Holmes, J. R. Lowell, J. G. Whittier, G. Bancroft, W. D. Howells, G. W. Curtis, T. B. Aldrich, Bret Harte, E. C. Stedman, R. G. White, E. E. Hale, G. W. Cable, Henry James, Mark Twain, C. D. Warner, H. W. Beecher, J. F. Clarke, R. H. Stoddard, W. D. Whitney, Walt Whitman, Asa Gray, Noah Porter, John Fiske, T. A. Woolsey, A. B. Alcott, Julian Hawthorne, J. Burroughs, M. Hopkins, T. W. Higginson, J. G. Saxe, O. B. Frothingham, G. P. Fisher, M. C. Tyler, C. A. Dana, D. G. Mitchell, A. Winchell, E. P. Whipple, G. P. Lathrop, W. W. Story, and F. Parkman. The following writers—Marion Crawford, E. P. Roe, G. T. Curtis, Edward Eggleston, and Joaquin Miller, all of whom in this country are far better known than many of the successful authors—did not obtain sufficient votes to qualify them for a seat. This summer an imaginary British Academy has been formed by a similar process. The forty chosen ones are:—Lord Tennyson, Professor Huxley, W. E. Gladstone, Professor Tyndall, G. A. Sala, Mr. Ruskin, Herbert Spencer, Matthew Arnold, Sir H. Thompson, W. Black, Sir J. Lubbock, Duke of Argyll, Leslie Stephen, George Meredith, Sir Richard Owen, Cardinal Newman, Mr. Browning, R. A. Proctor, Mr. Froude, John Morley, Lord Dunraven, Henry Irving, A. C. Swinburne, E. A. Freeman, Walter Besant, Edwin Arnold, G. Macdonald, Justin McCarthy, James Payn, Mr. Wills, W. Morris, Professor Blackie, Archdeacon Farrar, Baring Gould, Wilkie Collins, Lord Lytton, Professor Skeat, Andrew Lang, Professor Gardiner, and Austin Dobson. Some great names are conspicuous by their absence from this list, but the selection is not, upon the whole, an unrepresentative one.—*Daily News.*



"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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MAGNIFICATION NEAR HORIZON.

[1887]—I hope Mr. Proctor will not disdain to dispose of what I venture to offer in support of Prof. Le Conte's view, rather than of his, on this phenomenon (Knowledge p. 90).*

1. If these bodies have been measured, and found to subtend the same angle when apparently large as they do some hours after, when looking small, then I suppose, *causa finita est*; it is an illusion in very truth. Mr. P., however, does not say they have been so measured. [Have I not?—than I now say it—they have repeatedly been measured.—R. P.] If they have, the matter will always remain a puzzle to me, [!] for the following reasons (the test of the half-inch disk seems to me rather too rough a one):—

2. It is not by any means always, or in the majority of cases, that these bodies seem thus magnified. I have seen them approach the horizon hundreds of times, not undergoing this change of appearance.

3. It is not only the heavenly bodies which are magnified by certain states of the air. Thus, I sit down on the rocks and gaze at the opposite coast ten miles distant. I see the beach, but I do not see houses, mills, hedge-rows even. I read for an hour, and on rising to go, am astonished to find that, without any apparent change in the air, I now do see all these things, though my sight is fatigued by reading, as though I had gone three miles towards them in a boat. It is certainly not refraction which has done this, because I saw the beach at the beginning; the objects then too small to be seen were, therefore, in the field of view all the time. One day on the jetty at Boulogne, in bad weather, I remember seeing a church some distance inland in Kent. Now, on very clear days the cliffs are visible, but no buildings. How could refraction, by merely throwing up the object, make it visible, when a similar object, much nearer, is not so? [I will not pretend to explain an observation which has been made by another, and with the details of which I am not fully acquainted. But in such abnormal atmospheric conditions as are involved in cases of mirage, magnification is quite possible.—R. P.]

4. I may deceive myself; but I have always thought I saw, when the moon is so broadened, details on her surface which I do not usually see with the naked eye. Likewise, I have seen spots on the setting sun which I hardly think are visible when he was high up.

5. The eclipsed moon looks very much smaller than before; this is due to the absence of radiation [!]. Now, when she rises faint and cheese-like in the daylight, before the sun is set, she is free from radiation also, and should look smaller, as when eclipsed. This should at least counteract the other illusion. But it does not; *ergo*, &c.

6. I agree that comparison with other objects cannot be the cause; because, if we are in a deep valley, yet gently sloping, the moon rising above our apparent horizon does not undergo this change.*

7. I cannot agree with Mr. P.'s belief about the apparent shape of the sky. When there is driving scud, of course, the clouds overhead do look nearer than those lower down, because they go faster, and we instinctively conclude thence that they must be nearer, as, indeed, they are. (Also, they are vaguer and fleecier, and we get the idea that these details must indicate nearness.) But, as regards a clear sky, I cannot say the part overhead looks nearer than any other; rather the reverse. The same with an even dull sky. Both that and a clear one do give me the idea of a line hemisphere. (In 1873 I went, with French friends, into a cyclorama of the siege, at Paris. It was a dome—of course, a true hemisphere—painted cloudy; the environs of Paris were so well perspectived that, at first, one could hardly credit it was but a show. There were two boys—of eight and thirteen—with us, and for some time we could not convince them that the dome was not the real sky. I think this goes to show that the common conception is of a hemisphere.)

8. My own conclusion always has been that dew, fog, or rain in the air does magnify; but if the micrometer positively disproves this, throwing us back on the certainty of illusion; then, at all events, I urge that (2) *supra* shows that we have not arrived at the *vera causa*. Hallyards.

* Are there not two slips of the pen. "Nay, she looks rather smaller when near the horizon, being then nearly 4,000 miles nearer to us than when overheard." For "nearer to" read "further from"? Again, *infra*, "is larger when low down than she is when high above the horizon, though in reality occupying as large (nay, even a slightly larger) portion of the visual field." Here should not we insert "when high" after "occupying"? [Quite right, in reply to both points.—R. P.]

* Apropos. I read in a French paper that one effect of the earthquakes in Spain at a certain place had been to make the sun rise half-an-hour later every day. This, at first sight, recalling Joshua, or the famed earthquake pills, is, of course, quite correct, the mountain-range to the east of that town being elevated.

"DOUBLING UP YOUR HAVES."

[1888]—I am very glad to find that Mr. Procter does not really defend the phrase, "I should have liked to have seen." (In my letter, 1881, the compositor omitted the "d" in liked.) I see that Dr. Hodgson, in his "Errors in the Use of English," speaks of "the error of using the perfect form of the infinitive, for the simple or indefinite form, after a perfect verb," and says that, "in making a present statement past, only the principal verb need change its tense." He then goes on to give examples of this mistake from the writings of well-known authors, including Sidney Smith, Shelley, Sir S. Romilly, John Ruskin, F. W. Farrar, H. L. Bulwer, W. S. Landor, &c. This formidable array of names almost neutralises the previous condemnation.

Mr. Proctor says he never uses the phrase I object to, and I have certainly never detected it either in his writings or in his lectures. I was, therefore, the more surprised to see that he, as I thought, approved of it in certain cases. But I am glad that I was mistaken. E. C. H.

P.S. What Mark Twain says on this subject is as follows:—"Harris said that if the best writer in the world once got the slovenly habit of doubling up his haves, he could never get out of it while he lived. That is to say, if a man gets the habit of saying 'I should have liked to have known more about it,' instead of saying, simply and sensibly, 'I should have liked to know more about it,' that man's disease is incurable. Harris said that this sort of lapse is to be found in every copy of every newspaper that has ever been printed in English, and in almost all of our books. He said he had observed it in Kirkham's Grammar and in Macaulay."—From "A Tramp Abroad," by Mark Twain.

MISPRONUNCIATION.

[1889]—When first I had to study the elements of philology, with a view to teaching them, Grimm's law burst on my understanding as an absolutely new idea. "Trench on Words," and similar books, had prepared me for the wonderful fertility of roots and curious derivations; but, although I had learnt at school that care was more nearly connected with *gravis* than *cura*, and I had heard much about the digamma, the idea that one people systematically pronounced as *k* what their neighbours pronounced as *g*, and *vice versâ*, had never entered my head as possible, much less probable. My idea was that mispronunciation occurred from laziness or inability to pronounce a certain letter, *e.g.*, the Portuguese and the letter *h*. But, as a rule, it is evidently not so. The cockney who tells one that "the 'orn 'as been 'eard on the 'ill" takes particular pains to "hexplain the hillness of his haunt." The Roman, too, who used the word "granum" also made use of the word "cornu." It is not, therefore, an inability to pronounce a letter, but rather an inability to re-pronounce certain letters from the lips of a foreigner. While in India I had a certain amount of experience in teaching young natives English, and many of them came to me knowing absolutely not a word of it, so learnt their first pronunciation of a word from

me. I mention this as, of course, some of the English-speaking native masters themselves mispronounce. In every case that came before me the boy on the first attempt pronounced "wool" as "ool," yet the sound of w is distinctly heard in one of their commonest pronouns "woh." Another common mispronunciation is to place a short vowel before double consonants, such as sp, st, sm, &c.

It is most amusing to hear a conscientious native master trying to correct this fault. "Don't say *is-spot*; say like me *ispot*." A very peculiar mispronunciation, not made by the natives, but by uneducated Europeans in India, is the substitution of the English *a* for the vernacular sound of *u* in tub. It is true that in some of the later systems of transliteration this letter is represented by *a*, but the uneducated European does not know this, he gets his pronunciation from the camp-followers and others that hang about cantonments. One of the commonest words in use among the natives is *abhi*, meaning "now," pronounced uh-hee by themselves, but by the British soldier, *abbey*. No native would dream of pronouncing it so. Of course one does not expect the untrained ear to distinguish between dental and palatal t's, or between g and gh, and suchlike, but there seems something odd in words which are constantly heard as saláam, ubhee, gháriwán being invariably pronounced as slam, abbey, and gărriwann.

I have collected a few words from Raja Siva Prasad's "Hindi Grammar," which he gives as words in common use among the natives, but derived from English. They are, I fear, too few to draw any conclusions from, except that the liquids seem interchangeable. I have added a few words I have noticed myself, but they do not help. From the list of mispronounced names which I have added, it is apparent that the native tries to connect some meaning with the name, but the list is chiefly interesting in showing his ingenuity in so doing. Some mistakes, most amusing to those who know better, are made by tourists in India in the pronunciation of Indian names, such as Benairs for Benares, Oodh for Oudh, Peshawár for Peshawur, Cabool for Cábul, &c.

List of words from Raja Siva Prasad's Hindi Grammar:—Box, Bukkus; Breakvan, Brikbân; Button, Bŭtâm; Bottle, Bótŭl; Bag, Bég; Decree, Digree; Engine, Unjun; General, Jernél; Lantern, Lâl-tén; Lamp, Lump; Lord, Lât; Longcloth, Nainkilât; Number, Lumber; Note, Lote; Special, Ispéshal; Stamp, Istâmp; Tandem, Tumtum.

Additional list:—Baby-girl, Beebee, which really means lady; Baby-boy, Bâbâ, which really means son; Madam-sahib, Mem-sahib; Coachman, Coachwân; Peg—*i.e.*, Tent-peg—Meg; Champagne, Simpkin.

List of transformed names:—Alexander, Alekjullunder; Bradford, Brass pot; Bartlet, Bottley; Bartle Frere, Bottly Beer; Brown or Burn, Brune; Coles, Kuola, meaning charcoal; Abercrombie, Bikram, meaning goat; Mackintosh, Mukkun toost, meaning butter and toast; Johnson, Jân Sén; Thomson, Tâm Sén; Smith, Ismit; Vanzulicum; Bijli, meaning lightning.

There are, of course, many others, but I cannot recollect them at this moment. Jos. W. Alexander.

THOUGHT-INDUCTION.

[1890]—I am reminded by an article in the summer number of *Mayfair*, entitled "Telepathy," of a very popular argument against those who think they see some resemblance between Electric (or Magnetic) Induction and an induction of ideas which they affirm does sometimes take place between two or more minds; and now that Mr. Irving Bishop threatens to bring another thought-reading action against Mr. Henry Labouchere, this contribution to articles on the subject may interest those who have read with attention accounts of the former gentleman's late feats and failures.

Now it is a fact well known to all who have any familiarity with electricity and magnetism that an electric current in a body inductively affects the electric condition of all bodies in its vicinity, and that between a magnetic needle for instance and any other magnetic substance in proximity, there must exist an analogous sympathy, if I may use the phrase.

To illustrate these facts for the benefit of those who have not studied the matter, if two cables were stretched across the Atlantic, for instance, at a distance of, say, one yard from each other throughout their entire length; if certain electric signals were sent through one of these cables the same signals would be induced in the other and parallel cable, and might be observed at either end of the same, so that if a magnetic needle were moved into any position there would be a tendency for all magnetic substances in the vicinity to take up a new position as a result of such movement.

Now, as to induction of ideas. If such induction exist, can we reasonably consider that there is any resemblance between such induction and the electric or magnetic induction I have mentioned?

The author of "Telepathy" makes use of an argument which I have often seen adduced, but which I have never seen combated. "As for the analogy of electricity," he says, "it is wholly misleading. One magnetic needle acts on another at a distance, it is true, but the phenomena are regular and uniform. They are capable of exact prediction. They are, in short, matter of exact science." As for the alleged instances of thought-reading, I need hardly remind all who read this that they are very few and far between.

Now, to give the electric analogy a fair chance we should state facts correctly. To refer to the action which one magnetic needle exerts over one other at a distance, it is quite true that if we know everything about these two needles, and can place them where no third influence can bear on them, we shall be able to predict with certainty what will be the force exerted by each magnet on the other; but we must recollect that were the magnet we wish to act upon with one other magnet surrounded by other magnetic forces the effect would be the resultant of all the forces, and would in all conceivable probability not be equivalent to the effects of the one magnet by itself. Mesmerists sometimes ask their subjects to gaze intently on some uninteresting object, such as a plain zinc disc, in order to free their minds as much as possible from surrounding forces, so that there may be no conceivable force other than that emanating from themselves, the mesmerisers, brought to bear on the subject's mind. And if once we agree that one mind is inductively affected by another, we shall surely not have to give up the electric analogy for any reason yet assigned. We shall rather understand why cases of thought-reading, clairvoyance, and the like, are so exceptional instead of being the rule. The mind would have to be abnormally free, so to speak, or the one force which was to make itself felt would have to be so correspondingly powerful as to be able virtually to annihilate the resultant effect of all the other inductions bearing on it.

But even assuming that we could believe in the doctrine of Telepathy, we can hardly expect that cases of clairvoyance or thought-reading can ever become frequent. What an infinite number of factors make up the resultant force which determines a man's thoughts and actions! As every successive wave dashes on the rock, the spray in fury lashed assumes each time a different form. Who will predict the form which the spray shall assume next time the wave shall break? Yet if we knew the angle at which the wave would strike, as well as its shape and volume, the force and direction of the wind, and all the other elements or factors, we could draw an accurate prophetic sketch of the resultant. Is it therefore too much to assume that if we knew all the factors in the case, we might determine what a man's thoughts or actions would be under any given circumstances, if only we could work out the sum thus set—given the forces, to find the resultant?

In conclusion, I would remind all that we cannot positively aver that such is not the case, and I feel confident that such a belief could only work good. Our hatred of evil-doers would give place to pity for them, and thankfulness that circumstances have rendered us happier in our actions, and we should be filled with a desire to do our utmost to make that greatest factor in the world's good—knowledge—attainable by all. Herbert Kingsford.

MENTAL DEVELOPMENT.

[1891]—"Later on, Greek art, like art everywhere, declined, and, with occasional . . . . exceptions, never revived again."

This is so true a truism that it is not worth while to annex the reference.

Not in Greece only, but *un peu partout*, we see material proofs of the decline of man as regards art. Where are the artists of Baalbec, Nineveh, Luxor, Stonehenge, Yucatan, Easter Island, Cambodia? They all, in some respects, excelled us Europeans, who are a compost of the Italian, Celtic, and German savages of old. We have excelled them in a hundred ways; yet not in art. Is man never to be *universally* superior; not perfectible; now emerging, now submerged, like the shell he dwells on?

The idea might be carried much further. Thus, civilised man is less able, in many things, than the savage. Man, everywhere, is in many respects inferior to the beasts. What he has gained in dominion over the forces of nature, he has lost in morals. No animal is so contemptibly malignant, so illogical, as man; or so ridiculous in his actions. I know a horse whose sole occupation consists in pulling round and round a number of models of his species, on which are seated numbers of ours—not models, but grown-ups, as well as children, "all alive oh!" to the accompaniment of an extended repertory of *four* opera airs. I fancy I see in his eyes (and ears) the sentiment "How sad is my lot, to have fallen under the yoke of creatures who are not even sane!"

There was an old Frenchman who had a donkey, which he systematically ill-treated. One evening, as soon as the last bit of

harness was removed, the ass turned round, floored his master with a well-planted kick, and then leisurely and systematically kicked him all to pieces. If I had been by, I should not have interfered. Turn and turn about is surely fair play. I saw a man the other day beat his horse till he could strike no more; it could not stir a too heavy load of sand. Then he shouted to some fellow-brutes to lend him *two more* horses. Then he turned to contemplate his own beast. I thought he was moved with compunction. Suddenly he roared "*Sacré cochon!*" and struck his beast *again!* Don't talk of human superiority after that. HALLYARDS.

MEAN-TIME SUN-DIALS.

[1892]—The following hints may be acceptable to those who wish to set up mean-time sun-dials. The construction, though not mathematically exact, is, I think, sufficiently so for all practical purposes.

I premise that the reader is already acquainted with what has appeared in KNOWLEDGE on this subject.

I would not have the radius of the hour-circle more than six inches, or the shadow of the gnomon will be too indistinct.

The axis of the gnomon may be a stout steel wire. The waist may be made as thick as is necessary for strength, as this can be allowed for on the hour-circle. I mean to try if plaster-of-Paris will do for the material of the gnomon itself.

I do not see any special reason for making the two bulges of the gnomon of equal diameter, and I propose, in drawing the curves, to use as simple formulæ as possible.

The ordinates and abscissæ may be drawn from intervals of a week or ten days. For the latter multiply six inches by the tangent of the declination, for the former use the radius of the wire (waist) plus the sine of the equation of time.

The section of the gnomon when drawn might be transferred to a thin sheet of metal and cut out, so as to serve as a gauge.

I use one dial with two gnomons. The axes of the latter may be made as long as convenient, with their ends fitting into slots, so that they may be changed when required.

If the gnomon consisted of a cylinder of, say, a tenth of an inch diameter, it would cast a tolerably clear shadow of the same width, and, at apparent noon, the *axis* of the shadow give the twelve o'clock mark. It is necessary, therefore, to give the hour circle a movement round the axis of the gnomon so as to set the edge of the shadow to the exact time.

From Christmas to the middle of April, and from the middle of June to the 29th of August, the east side of the shadow has to be used; at other times the west. When the change of edge has to be made, the hour circle must be revolved the width of the waist of the gnomon. A similar motion is, of course, used (if required) to set the dial to any given standard time instead of local mean-time.

The gnomon and hour circle must be braced together, and the combination be capable of two motions—one round its axis, as just mentioned, the other in a vertical direction to set it for the latitude. The lower end of the gnomon (or rather its support) has a hinge, and the upper end is clamped to a graduated arc according to the latitude.

When my dial is finished I mean to test it from time to time by a chronometer.

I see that in my letter 1825 I inadvertently used the expression "sine of half the equation of time" for "sine of the equation of time." MUSAFIR.

OCULAR SPECTRA—THE RETINAL DECOMPOSITION OF LIGHT.

[1893]—It is very remarkable that Newton's celebrated prismatic experiment should be commonly regarded as the first demonstration of the composite nature of what is vulgarly termed *white-light.* The rainbow was Nature's demonstration of the same fact from all time. The decomposition of light by the prism, as well as by little water-drops, is attributed to refraction. The decomposition of light, however, has also been effected, from time immemorial, in a very different manner, without refraction—I mean by the optic sense, by the sentient human eye, as experienced in the phenomena, or spectra consequent on *sun-daze.* The duration of these spectra on the retina is of sufficient length to enable an observer to experiment with them, and to discover that the prismatic colours succeed each other in contrary order, as these may be experienced either in a dark or in a light field of vision. One of the most interesting experiments which may be made with these spectra is, that of turning the eye either from a light on to a dark field or *vice-versa,* when the spectrum of the moment will appear of the opposite or complementary colour, assuming its previous hue when the eye is again turned upon a light field. When this remarkable fact shall have been sufficiently considered in all its bearings, it will, in all probability, lead to some important changes in our theoretical conceptions.

1. If the sensation of a particular colour be due to a wave of a certain periodicity, how comes it that that wave period can be immediately changed into that of its complementary and back again within certain limits of time?

2. If what is usually called the decomposition of light be a veritable decomposition, this decomposition, it is evident, may be effected without refraction.

3. The decomposition, thus effected, is not sufficiently accounted for by the suggestion that the sequent sensations of colour follow each other according to the strength of the impressions made upon the retina by the respective component vibrations constituting white light, that is to say, the weaker fading first and the stronger last; for, if this were the case, the spectra would preserve the same order of succession whether in a dark or in a light field of vision.

4. Seeing that identical portions of the field of the retina may experience alternately, and almost simultaneously, opposite sensations of colour, these spectral changes must be due to the proportional relation of the excitement of those portions to their environment.

The most feasible explanation of the sequent spectra referred to appears to me to be offered by (4) viz., that those sequent spectra are intervals in the decadence of a strong initial impression on the retina, and that the different sensations of colour experienced are due to differences of degree rather than of kind, just as our different sensations of heat and cold are, and that just as in the case of temperature the sensation produced by any particular degree may be changed by juxta-relation to some other antecedent or consequent. W. CAVE THOMAS.

A TRICYCLE QUERY.

[1894]—Would Mr. Browning oblige by describing a tricycle suitable for a man weighing 16½ stone, fifty years old, and, consequently, not as active as he might be. A safe, easy-going, and tolerably swift machine (not for racing) is what is wanted. The Globe Lein seems to me to be about what is required. Am doubtful whether a single or convertible machine would be best.

SIXTEEN AND A-HALF STONE.

SWANS FLYING.

[1895]—I send the following, as I think some of your readers are doubtless interested in natural history:—

At 7.40 p.m. I observed three swans [What kind?], at a fair elevation, flying in a direction from S.W. to N.E. Heads and necks were well stretched out; but, from the rate at which they travelled, they did not appear at all fatigued. H. A. MILES.

Aug. 14.

OIL-GLAND IN DUCK.

[1896]—Article "Philosophy of Clothing," p. 115. I think it would be well to finish one heresy before beginning another. I take it that it is well understood by most persons who would be likely to read this paper that down of the duck lies inside the feathers next the skin, that it encloses a large quantity of air, and that still air is an excellent non-conductor of heat; but this has nothing to do with the little organ in question, nor is the grease or yolk in the wool of the sheep an analogous illustration, as that applies to the whole surface of the body of the animal; nor does any of this prove the existence or non-existence of an oil-gland in the duck. Mr. Williams is not likely to find much, or any, oil on the down-feathers of the breast, as it appears to be mostly distributed on the external surface of the outside feathers; but if Mr. W. will catch his "loving and faithful duck" again, and examine the other end of the bird, he will find that he can press out of the nipple before-mentioned a yellowish thickish substance, which, if not oil, is certainly greasy, and at times the feathers in the neighbourhood of the organ are so moist and slippery from the same that they cannot be plucked out by the fingers. Moreover, a domestic duck, unlike a fowl, is not an animal "usually infested with fleas," as Mr. W. states (am sorry to disagree with him again), provided that it is not kept in confinement and has plenty of water.

In "North American Birds," by Elliott Coues, date 1872, at page 5, I find an anatomical description of the oil-gland (too long to insert here). "Bird Life," by Dr. A. E. Brehm, date 1874, page 10, a shorter description. "Zoology," by H. A. Nicholson, date 1870—lecturer on Natural History at Edinburgh refers to it (page 268) as an organ of great development in the order *Natatores,* by means of which the dense plumage is kept constantly oiled. And "Anatomy of Vertebrate Animals," by T. H. Huxley,

at page 275, distinctly states that it is an organ for the secretion of an oily fluid which the bird spreads over its feathers by the operation of pruning, and speaks of it as generally understood and without a doubt. Besides which a duck and a dissecting knife are quite sufficient to prove the correctness of the above quotations, or even without the knife. G. A.

ILLUSORY TRANSFORMATION OF INTAGLIO SCULPTURE INTO APPARENT BAS-RELIEF.

[1897]—A very pretty object for experimenting in this illusion is found in the reverse side of the embossed "Queen's head" or postage-stamp impressed on stamped envelopes, and it will be interesting to many of your readers to examine such an object both by daylight and by artificial light.

Unless my experience is exceptional, it will be easy for observers to cause the image of the features to appear to assume the more familiar aspect of a convex or rounded surface instead of their true shape of a concave or hollow, and, aided by this illusion, to fancy that the hollowness of the engraved oval lines by which it is surrounded is transformed to an untrue solidity. In all these effects there is a false supposition of the illumination being in the opposite direction to its real incidence, or, rather, at an unequal angle, but on the opposite side of a perpendicular to the general surface of the paper. The human face being such a constant object of observation not only during our own lives, but throughout the long experience of the race, while hollow-moulds of it or of other familiar solids are rarely seen, it is much easier to fancy that the hollow cast is solid than the reverse. In fact, though in close proximity to the intaglio, and while it appeared to stand up in beautiful relief, yet it was impossible to depress mentally the features on a coin laid upon the paper. It will also be observed that contradictory results may be observed by introducing a few indentations in the paper or throwing sharp shadows upon it, when, though the over-mastering familiarity of the features enables us to hold them to the fancied *relievo* appearance, yet these mouldings, wrinkles, depressions, &c., retain their true aspects, and wholly or for a time refuse to be transformed, and the surface appears to be lighted from opposite quarters simultaneously. It would also appear that monocular vision and slightly unfocussed vision are favourable to the inversion of the perception, and that slight crossing of the axes of the eyes, or causing them to be directed to vision "at infinity," helps to form the illusory conception. J. Greevz Fisher.

MUSICAL TEMPERAMENT.

[1898]—In my last letter I left it to be inferred that to take any notice of such a difference among the ratios of vibrations as that between 8 : 9 and 9 : 10 was something as irrelevant to music considered as an appeal to the understanding, as it would be in criticising an architectural work, to make a microscopic examination of the bricks to see whether they actually corresponded to the *beau idéal* of a brick. But it may now be well to collect and compare a few conflicting authorities.

The late General Perronet Thompson contrived a most ingenious and complicated organ for playing in a variety of keys, with scales justly intoned; and he wrote a book upon it full of curious information, which went through several editions. To his feelings, just intonation and equal temperament seem to have been opposed, as truth to falsehood, right to wrong. He says: "If a sculptor, instead of making fingers of the various lengths nature has made them, should determine to make one medium length serve for all, this would be a temperament." . . . . . "It is as if sailors and astronomers were invited to employ telescopes fixed to one length for all eyes and distances, like those sold for children in the toy-shops" (General P. Thompson's "Just Intonation," 7th edition, p. 45). "The misery of temperament must be got rid of. . . . ." (p. 50). "Singers sing to the pianoforte because they have bad ears, and they have bad ears because they sing to the pianoforte" (p. 94). "The tenth of an inch may in some senses be called small; but it is a mountain in the edge of a razor or the nose of a profile." . . . . "As it is, the singers and violists live in a constant struggle with the temperament, and get rid of it as far as they are able, though a portion sticks by them in the shape of accustoming their ears to what is out of tune." . . . . "Instead of being a 'slight imperfection,' it is ruinous to all approaches to perfection; a man might as well try to shave himself with a handsaw, and persuade himself he liked it" (p. 95).

General Thompson had his sympathisers. He quotes from De Morgan, "The system of equal temperament is, to my ear, the worst I know of." One enthusiastic young lady said, "But for this organ" (General Thompson's) "I should never have known music. I did not like it, and could not understand it." "It's quite a treat!" exclaimed a professional tuner, after tuning the just instrument: "When I have tuned my chords in a tempering organ I have to make them say *Wow, wow, wow*, for the temperament." ("Just Intonation," pp. 96, 47 and preface.)

To turn away from General Thompson, I quote Helmholst, in his chapter xvi., "The System of Keys," of his great work, the "Sensations of Tone," &c., as translated by Mr. Ellis:—"There can be no question that the simplicity of tempered intonation is extremely advantageous for instrumental music . . . . But it must not be imagined that the difference between tempered and just intonation is a mere mathematical subtlety without any practical value. That . . . . the early musicians, who were still accustomed to the perfect intervals of vocal music . . . . felt the same, is immediately seen by a glance at the musical writings of the latter half of the seventeenth and the earlier part of the eighteenth centuries, at which time there was much discussion about the introduction of different kinds of temperament" . . . . "Whoever has heard the difference between justly-intoned and tempered chords can feel no doubt that it would be the greatest possible gain for a large organ to omit half its stops, which are mostly mere toys, and double the number of tones in the octave, so as to be able, by means of suitable stops, to play correctly in all keys." (N.B.—The translator demurs to the absolute accuracy of this.) "Down to the seventeenth century, singers were practised . . . . with a degree of care of which we have at present no conception." . . . . "But it is impossible not to acknowledge that at the present day few even of our opera singers are able to execute a little piece for several voices . . . . unaccompanied . . . . in a manner suited to give the hearer a full enjoyment of its perfect harmony." Professor Helmholst here instances the trio for the three masks in "Don Giovanni.") . . . . "When the intonation of consonant chords ceased to be perfect . . . . it was necessary . . . . to have recourse to a frequent employment of harsh dissonances . . . . to replace the characteristic expression . . . . These are unpleasant symptoms. . . . . Our last greatest composers, Mozart and Beethoven, were yet at the commencement of the reign of equal temperament." (Ellis's "Helmholst," 1875; pp. 498, 504, 508, 510, 511.)

⁂ An opposed view will require a future letter.

A. O. D.

THE CORRELATION OF THE TWO COMMON CHORDS OF MUSIC, AND THE BINARY CHORDAL STRUCTURE OF THE MUSICAL SCALE, AS ILLUSTRATING EVOLUTION.

[1899]—In letter 1850, reference is made by "Gamma" to the serviceable use which is frequently made of music for the purpose of illustrating the character and mode of nature's processes; and as, in connection with that subject, I think I am able to add something to the existing store of knowledge, I am induced to offer my humble contribution.

If not well-known to all, it is at least easily found that the first six numbers, viz., 1, 2, 3, 4, 5, 6, represent the ratios of the major chord in a complete form. Take, for instance, the major chord of C; C_1, C, G, c, e, g. Observe that there are present in it, in ascending order, the harmonic intervals the octave, the fifth, the fourth, the major third, and the minor third. When it is stated that the six numbers above given represent the ratios of the major chord, it is of course understood to be signified that with one vibration of the fundamental note C_1, two vibrations of C coincide; three vibrations of G, four vibrations of c, five vibrations of e, and six vibrations of g.

So far we have come upon nothing new. To what follows, however, I think I must ask for a little heedful attention, for though it is not a matter presenting much difficulty, it is one, I have no doubt, now presented to readers for the first time.

As the numbers 1, 2, 3, 4, 5, 6, are the ratios of the major chord, so are their reciprocals 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, the ratios of the minor chord. To instance the minor chord as represented by these ratios, let us take that called the minor chord of A, which appears as e^1, e, A, E, C, A_1. In this chord the series of the harmonic intervals again appears, but in contrary, that is in descending order, viz., the octave, the fifth, the fourth, the major third and the minor third. The interpretation of these reciprocal ratios in relation to the minor chord is this: the uppermost note e^1 is the note of origin, or, of the unit, and there coincide with its single vibration one half of a vibration of e, one third of a vibration of A, one fourth of a vibration of E, one fifth of a vibration of C, and one sixth of a vibration of A_1.

It is thus shown that the relations of both the major and minor chords arise equally from the simplest origin, that is, the unit, the single vibration; and that these relations with this unit are of equal simplicity. And we here observe that of these two chords

the whole system of scales, modes, changes of key, &c., are undoubtedly built up. Into this part of the subject we now pass.

It is a matter of experience that all the notes of each chord may be sounded together, and in each instance the effect produced is harmony, but harmony however of a different quality, easily distinguishable, and known as major or minor. But the effect of harmony is destroyed if both chords are sounded together. They are not competent for this kind of union. But there is a kind of union of which they are susceptible, that is the union which consists in the immediate succession and alternation of the notes of the two chords amongst one another, the result being song, tune, or melody. We purposely omit to speak of the heightening effect of rhythm in music, which is not requisite to take notice of here.

We therefore now see how the scale is built up. It is by the affinity of chords which have one or two notes in common. Such the affinity is between the two chords we have been employing by way of illustration. The notes c and e are common to both. By uniting, then, these two chords we obtain a considerable portion of the diatonic scale, that is, one half of it, viz., (omitting octaves) C, e, g, a. The remaining half is thus obtained :—Upon G erect another major chord. Reduced to the brief four of a triad, this chord is g, b, d'. This d must be called d acute. It is the acute second of the key of C. Likewise join to A of the minor chord described another minor chord. Reduced to its triad form this new minor chord is a, f, d\`. This d must be called d grave. It is the grave second of the key of C. The two forms of the second of the scale differ by the ratio 80 : 81.

This second pair of chords conjoined to the former pair complete then the construction of the diatonic scale, which in the key of C consists of these notes, as placed in one octave, C, d′, d\`, e, f, g, a, b, c, the respective ratios of which are 1, $\frac{10}{9}$, $\frac{9}{8}$, $\frac{5}{4}$, $\frac{3}{2}$, $\frac{5}{3}$, $\frac{15}{8}$, $\frac{1}{2}$.

But the diatonic scale is not the only scale; or, to speak more definitely of its nature, it is only a part of a continuous system of notes. It is, however, the most important part; in fact, the one necessary parent stem, of which all other scales, keys, and notes not contained within it, are but as branches and leaves growing naturally upon it. These ramifications result from the mere continuation of the process by which the diatonic scale is formed, to wit, the bringing forth of new chords, both major and minor, upon the notes of already produced chords. Whatever be the form of scale or new note which may appear in examples of music, it is of necessity related to the keynote, and its correlative by an unbroken chordal linking that has existence in one direction or another.

It will be proper to say a word or two in connection with the liberty, which we have taken for shortness' sake, of condensing the notes within the limits of a single octave instead of detailing them in their respective positions in the order of the chordal development which determines them. Let it then be seen that this is done in strict accordance with the principle of simplicity of development; for, as in practice, a note and its octave are so much alike that they are regarded as being in unison; that is, in one sound, their agreement being of the next degree to that of notes of the same pitch, so is their mathematical relation the next to the ratio of unison 1 : 1, viz., 1 : 2, or 2 : 1. And it is to be further observed that the replication of this ratio or interval produces no change of key, which, we find, is effected by replication in the case of either of the other intervals. It is, therefore, quite legitimate, having determined a note, to place in the scale any possible octave of it.

Such, then, as an illustration of evolution, is the structure of the musical scale, which, however, it should be borne in mind, defines in reality the power of a measuring faculty or instinct, an instinct that measures sounds, the successful exercise of which affords pleasure to the soul, or emotional faculty.

Hence it appears that our faculties are also subject to the law of evolution, the principle of which may be defined as simplicity of departure from oneness of origin to manifoldness of result. This is abundantly found in the processes of physical nature. Take, for instance, the phenomenon of crystallisation. First there is the indivisible chemical unit, the atom; then the union of two atoms forming the molecule; next the aggregation of molecule to molecule building up the symmetrical crystal; and lastly, an irregular conglomeration of crystals united facet to facet. Thus there appear, first, oneness; then symmetrical duality; then diversity, still showing symmetry; and lastly, complexity not characterised by any necessary extension of symmetry.

Another point in the evolution of the scale to be remarked is the reciprocal nature of its duality, which appears as an economy in its construction, whereby a maximum of effect is brought about with a minimum of divergence; for by the addition of a single note to either chord the other chord is imitated.

To this inherent duality of the musical scale many analogues in nature might be adduced. There is one, universal in organised nature, which it may be of interest to mention—that is the division of sex.

In conclusion, I would remark that whilst the scale is thus shown to exemplify the law of evolution, it equally appears to exemplify design in nature, teaching, in fact, that evolution is the one simple mode according to which the purposes of nature are fulfilled.

Fred. J. Jackson.

LETTERS RECEIVED AND SHORT ANSWERS.

Jas. Brown.—The explanation of saltness of sea in "Chambers's Encyclopædia" is unsound. The salts which form ingredients of the crust have been derived from the sea. Doubtless the saltness of the sea is due to the presence in the earth's primæval atmosphere of those elements now found in the sea.—R. G. L. Quite agree with you.—F. W. H. The subject is disposed of. If nothing is anything to man until he becomes conscious of it, I opine that to 999 out of 1,000 readers of Knowledge, Hylo-Idealism is naught.—Atlas.—Dr. Wigan's book is long since out of print. I believe it was originally published by Longmans.—Constant Subscriber. Do not know the address. An editor has usually a good deal to do besides looking after such matters.—S. G. Only the feeling that it is best to say no more on a subject which should not have been touched on, prevents me from publishing your just and well-worded remarks. Ten lines of her writing outvalue all that those Pharisees (who can only judge, however, from their inner selves) have done of good in all their lifetimes. — Hilton Fulcke. The book is anonymous. Try the publishers, Baillière, Tyndal & Cox.—R. M. D. As a very busy man I cannot undertake to make the necessary inquiries. Note advertisements in our columns.—Zeteo. Of course. Or, Assume a finite line,—it can be produced, and produced again—for ever.—Boyd Moss. Have not read that book. There is so much to be done in this world, that those outside inquiries do not invite me. On the other point, it is the "popular conception" which overlooks that—not I. *My* ideas on the subject have no contact, even, with the popular conception. But what can it matter to the world what I think? That is the great nuisance of such subjects; they set a lot of unwise folk eagerly telling the world what *they* think—as if it mattered.—J. R. Corder. I am not the publisher of that work or of any other; do not know its price, or exact name.—Commentator. Readers object, and naturally, to disquisitions so exuberant and dealing so wildly with so many subjects. A change is preparing which will leave very little room for correspondence, and none for replies in the Knowledge of the future. We begin by eliminating letters running to extravagant length, and too variegated in texture. Your suggestion that we should go through your letters and select what is best is all very well; but in the words of the good Bishop Peter of Rumtifoo, how about "*Time* my Christian friend?" As for the question you ask about General Grant, I know nothing about General Grant's private character; nor if I did should I deem it right to say anything about it. My own private personal character is quite enough to look after. Garfield's misdemeanours were public. He was not only publicly accused but publicly tried and publicly condemned. Americans may satisfy themselves with the idea that his subsequent election to the presidentship did away with that public condemnation by the chief law-courts of the land. That is their affair. If they like stained men for chief rulers, we need not be concerned. But private faults should be kept private. Anything more disgraceful than the attacks made on the private personal characters of Messrs. Blaine and Cleveland can hardly be imagined. Yet the tone of our own party papers grows constantly lower and more vulgar where they deal with personal matters—and unfortunately we have few but party papers.—Hallyards. Your letter of the 18th came direct to me (R. P.). I refrain from conveying to my friend the acting-editor the advice you kindly proffer him. I do not think the letter you refer to can be rightly described as offensive; certainly the editor did not so regard it. Anyway I am responsible for omitting part of your reply. If you do not know, I *do*, that such remarks as you quoted, however seemingly with ridicule, about myself, would have an effect to which I might very properly object. You did not even correct what was untrue in them (I cannot but fancy there was a little spite in that paragraph—as in your suggestions to the acting Editor); and though the acting Editor would have done that, I prefer to be neither insulted nor defended in my own paper. For your personal information I may remark that I am not a B.A. of London, or of anywhere else but Cambridge. As for your "opposition" to my views, your remarks about bodies moving in straight lines showed too complete an ignorance of the elementary laws of physics to be regarded as seriously in opposition to anything—except known facts. Most emphatically your letter headed "Exit Hallyards weeping" cannot be admitted without alteration; but your other alternative suits the case exactly; with or without

your alternative suggestions, the letter would certainly have been "omitted entirely." It must be gratifying to be so well assured of the obligation under which you have placed us. I had an idea the obligation lay the other way. I could show you a round dozen of letters suggesting that *this* obligation had been carried too far. A change which will take place in Knowledge a few weeks hence was suggested by this feeling in regard to yourself and one or two others, almost as much as by any other cause. You will be able to judge from its nature how *I*, at any rate, view the matter. Letter on "Light of Eclipsed Moon" omitted because corona is not red; moreover the corona's light is demonstrably small compared with that coming directly from the sun. In those matters *some* things are known, not matters in dispute. I never for instance regarded my remarks on Mr. M. Williams's ideas as more than an attempt to make some known matters clear.—H. S. Hutchings. Mr. Proctor's lectures have never been printed,—or written: they vary from week to week, as knowledge grows.—L. E. You are quite right, of course: see "Gossip" for explanation of my strange mistake.—J. T. C. Darwin's "Descent of Man" is published by Messrs. Murray. I am not sure; but I think they have published a cheap edition. I hope so, for many reasons. Imagine such a feeble-minded person as you describe pretending to teach,—one might as well set a Mark-of-the-Beast coat and a white tie to tell men their duty,—only the coat and tie would have the advantage in being silent. I do not think the Acting Editor anywhere expressed the least objection to any one being a teetotaller. It was those who try to howl down the moderate drinkers he objected to. (By the way, why did you not finish the quotation from Sir Henry Thompson? Many agree with him in thinking that what is considered moderate drinking is often in reality excessive,—that, in fact, there may be mischievous excess without drunkenness being approached,—especially in the habit of systematic drinking. But the passage you partly quote bears a different meaning when complete than as you give it.) What I object to is the impudence of persons (not specially trained in medicine or physics) who pretend to tell grown men (myself amongst others) what we ought to do in such matters. Even when doctors talk about feeding, drinking, and some other matters, I note that they differ among themselves, and their practice differs often enough from their precepts; but they (some of them) *have* special knowledge. When Smith or Jones, with no more or perhaps much less experience than their fellows, tell Brown or Robinson (or R. P.) to drop their daily half-pint of claret, glass of beer, or wineglassful of sound whiskey or the like, or to go without tea or coffee, and so forth, said Smith or Jones must not be surprised if they are told more or less emphatically to attend to those details which appertain to their own affairs. We say to them, "Tell us your opinions, and welcome; but don't pretend to instruct, still less to denounce us, if we don't agree with you. I cannot drink beer, even a glass daily, or sherry, or port, or champagne, or liqueurs, without soon having to pay a penalty for taking what does not suit the constitution I have inherited. Shall I therefore try to stop my friend, the acting Editor, from taking what agrees with *him?* That's the spirit in which most of the teetotal teachers do their preaching. It is the same with doctrines of other kinds. It will be a pleasanter world (a few thousands of years hence, perhaps) when men mind their own business, and cease to proffer unasked advice to their fellow-men.

Notice.—In future weekly numbers of Knowledge, the answers to correspondents will occupy much reduced space. We can no longer undertake to answer all questions addressed to us, or to explain why letters intended to be published are not suitable for our columns.

REGINA *v.* WILKINSON AND OTHERS.

(*Household Journal* and *Golden Argosy*.)

To the Editor of Knowledge.

Sir,—Referring to the notice you were good enough to accord us in your impression of the 24th ult., we have received so many communications from your readers that it has been impossible to reply, individually, to them. We shall be glad, therefore, if they will regard this letter as a formal acknowledgment.

The defendants having absconded, we cannot continue the prosecution until one of the warrants now in the hands of the police has been executed. Immediately we are in a position to proceed with the matter many of your readers will hear from us more fully,—Your obedient servants, Best & Pitts.

57 & 59, Ludgate-hill, London, E.C., Aug. 22, 1885.

Our Inventors' Column.

CHIMNEY CLIMBERS.

[Patents No. 16,164, 1884; and 3,435, 1885.]—Messrs. Brown & Porter, of Leith-chambers, Moorfields, Liverpool, have invented a contrivance for ascending and descending tall chimneys, shafts, steeples, &c., which is remarkable both for its ingenuity and its simplicity. It consists of a staging which is made to creep up the chimney, upon which it also depends for support. Fig. 1 illustrates the design for circular chimneys, which forms the subject of the first of the above-mentioned patents. The staging is of a triangular shape, and consists of an upper and a lower stage connected by vertical columns at each corner; at the left side is seen a screw worked by the handle A, which serves to give the staging a tight grip against the chimney, the two corners of the stage opposite, what we may call the screw corner, being hinged for the purpose.

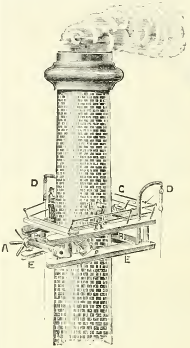


Fig. 1.

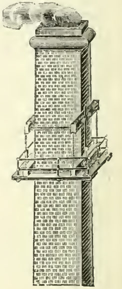


Fig. 2.

Three rollers, marked B, are provided and set at an angle, one in each side of the triangular stage; these rollers bear against the chimney, the one to the right can be turned round by means of a handle, worm, and worm-wheel, C. The effect of turning this roller is to cause the stage, as a whole, to gradually climb up the chimney with a spiral movement; of course, as the stage ascends and comes to a narrower part of the structure, it is necessary to tighten the screw, A, so as to give the rollers the necessary grip.

The form shown in Fig. 2 is simpler still, and is adopted to square, hexagonal, or any other shaped shaft. The apparatus consists of two stout timber grippers capable of being secured to the chimney to be climbed by means of two long bolts, one on each side the chimney; to these upper grippers are suspended (by means of four chains) two others precisely similar, capable also of being bolted to the chimney, and to the latter is attached the stage. The lower and upper grippers are also connected by means of two steel screws two inches in diameter. The operation of climbing the chimney is as follows:—Supposing the upper grippers to be screwed fast, and the lower ones to be loose, then the weight of the stage is being sustained by the chains; the two screws are now operated, and the stage is thereby gradually raised; when the desired height is reached, the lower grippers are secured by tightening up the bolts, which takes off the weight from the upper ones, so that the latter can now be raised to a greater height by simply working the screws the reverse way; when the chains are again tight, the upper grippers are secured as before, the lower ones released, and the operation of lifting is continued. The weight of the staging is about 11 cwt.

So simple and effective a device is sure to commend itself, fo

among the advantages pertaining to it may be mentioned :—the safety ensured to life and limb (it is said that 12 per cent. of the professional "Steeple Jacks" are killed or maimed annually); the tedious and expensive processes of kite-flying and ladder-fixing and climbing are superseded; architects, &c., can inspect the work without risk. All these are features which any one who has watched a "Steeple Jack" at work can easily appreciate, and it may be safely said that the invention has all the elements of success.

Our Chess Column.

By Mephisto.

ILLUSTRATIVE GAME No. 8.

"Stronger by weakness wiser men become."

An interesting game played in the late tournament at Hereford. Black in this game is too intent on arranging his Opening according to principles, and takes no heed of his opponent's manœuvres to mate him. We must profit by this example, and never lose sight of our opponent's designs in arranging our own.

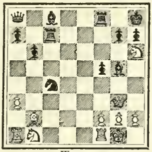
White. Rev. J. Owen.	Black. J. Gunsberg.
1. Kt to KB3	P to Q4
2. P to Q4	P to QB4 (*a*)
3. P to K3	P to K3
4. B to K2	Kt to KB3
5. Castles	P to QKt3
6. P to QKt3	B to K2
7. B to Kt2	Castles
8. QKt to Q2	Kt to B3
9. P to B4	P × QP
10. KP × P	B to Kt2 (*b*)
11. B to Q3 (*c*)	Kt to QKt5 (*d*)
12. B to Kt sq.	R to B sq.
13. Q to K2	R to B2
14. Kt to K5	Q to R sq. (*e*)
15. P to QR3	Kt to B3
16. Kt to Kt4 (*f*)	

Black.

White.

White. Rev. J. Owen.	Black. J. Gunsberg.
	P × P (*g*)
17. P × P	Kt to QR4 (*h*)
18. P to Q5 (*i*)	Kt to K sq.
19. Q to K4 (*j*)	P to B4 (*k*)
20. Q × P (ch)	K to R sq.
21. Kt to R6 (*l*)	B to Kt4 (*m*)
22. P to Q6	B to B sq.
23. Q to K2	Kt × QP
24. Q to Q3	Kt (Q3) × P (*n*)
25. Kt × Kt	Kt × Kt
26. Q to KKt3	B × Kt (*o*)

Black.



White.

27. Q × R	Kt × B
28. Q to B2	B to R3 (*p*)
29. Q × Kt	B × R
30. K × B (*q*)	

Notes.

(*a*) Rather risky to play this as second player. We have already stated in a game—Mackenzie *v.* Mason—that it is preferable to Castle before advancing this P.

(*b*) Black's play is directed against the advanced White Pawns. White cannot play P × P without isolating his QP, nor can he advance the P; whereas Black may play P × P, for if White retakes with P, he will have two unsupported P's on Q4 and QB4. Experience has shown that these Pawns are weak. These points in the position give Black a slight pull, which he may increase by massing his pieces on the Q's Pawns. For attacking purposes, perhaps B to R3 at once might have been better.

(*c*) While Black is absorbed in following up the principle of weakening White's Pawns, White attempts to prepare an attack against Black's K's side by the combination of moves such as B to Q3, B to Kt sq., and Q to B2, &c. White, however, would have done much better to play R to B sq. first.

(*d*) Apparently the Kt moves to a square from where it can easily be chased by P to R3. But this move in reality serves many purposes. Firstly, if the B remains there the Kt will take it off, which would put an end to White's designs against Black's K's side. Secondly, if B retires to Kt sq. the R is blocked in, and not available for the better defence of the QBP. Thirdly, if after the retirement of the B, White subsequently plays P to QR3, then White's Queen's Pawns are still more weakened, for after the Kt retires to B3 he will have a very good attacking square on R4, bearing both on the BP and KtP. As will be seen later on, all this was rightly forecast by Black, and came to pass.

(*e*) This is indeed unmindful of White's intention. A simple precaution such as P to Kt3 would have been advisable. Black, in a ponderous manner, made room to play KR to B sq., he also threatens the KKtP.

(*f*) A very natural desire on White's part to displace the Black Kt which guards the objective weak spot on Black's KR2. He also threatens Kt × Kt (ch) followed by P × P, in which case each side would have an isolated QP.

(*g*) This move gives Black a bad game. He ought to have played Kt to QR4 first, as originally intended, for if Q to Q3, then P to Kt3 would secure his position.

(*h*) Even now the following line of play would avoid trouble, viz., Kt × Kt. 18. Q × Kt, B to B3. 19. Kt to K4, Q to Q sq. (best), &c.

(*i*) A very fine move. Black now pays the penalty for his one-sided play. If Black replies with 18. P × P, then 19. Kt × Kt (ch) followed by 20. Q to Q3 wins. Or, if 18. Kt × Kt. 19. Q × Kt, P to Kt3. 20. P × P or 20. P to Q6 followed by 21. Q to Q4 gives White a superior game.

(*j*) Very well played indeed, and much better than 19. P × P, P to B4, &c. White gets the KP with a check.

(*k*) If 19. P to Kt3, 20. Kt to R6, mate.

(*l*) Encouraged by success, White becomes very ambitious. This is a showy continuation, especially as Philidor's mate is threatened by Q to Kt8 (ch), &c. In reality, however, Black's pieces were too well placed to allow White to get anything more now. His best move would have been 21. Q to K2. Black could not take the Kt on account of 22. Q to Q3. Against 21. Kt to K5 there is the objection that after Black moves B to Kt4 or Kt to Q3 the White Q will be liable to attack by R to K2 or B to B sq.

(*m*) A powerful move, which turns the tables upon White. Black threatens R to K2, or if the Q moves, B × KKt.

(*n*) It seems really that success has its dangers for the victor as well as the vanquished, inasmuch as it makes the former over confident in proportion as the latter puts forth his best efforts. As soon as Black escaped out of his difficulties he relaxes his attention. Here 24. Kt to Q sq. would have won the Kt.

(*o*) A simple way of liquidation. Black, however, still had a chance of playing to win the Kt by retiring his B to Q sq., protecting the R, if then 27. B to Q4, Q to B3. 28. Q to B4, B to B3, &c.

(*p*) Black had evidently overlooked that the Kt has no escape. Now B's of opposite colour remain, which leaves Black not sufficient to win. It would have made no difference if Black had played B to KKt4 instead of this move; for after 29. Q × Kt, B to B3 White would play 30. Q to Kt4, attacking the R and compelling B to R3, then 31. R to R2 would again leave B's of opposite colour.

(*q*) The game was abandoned as drawn on the 41st move.

Our Whist Column.

By "Five of Clubs."

WHIST DEVELOPMENTS.*

A careful study of "Whist Developments," by "Cavendish" has gone far to convert us to the opinion of Pembridge and others, that Whist as a game is in a fair way of being ruined. Whist developments are like fungoid growths, the signs and tokens if they are not the active agents of decay. "Cavendish" and his school seem determined to prove that those are mistaken who have said of Whist, "Age cannot wither nor custom stale its infinite variety"; for they try to substitute a series of cut-and-dried Cavendish rules for that beautiful variety which is the charm of the game. If Whist developments as developed in this book are adopted by Whist players generally, then Whist will no longer be a game. It may be a mental exercise, just as walking along a pavement is bodily exercise; but there will be no game in it.

Let us at the outset be understood as in no way detracting from "Cavendish's" claim to be considered a fine player, or even as rejecting the principles on which some at any rate of the rules he lays down in the present work are based. Although the game of his on which he has chiefly dwelt as a sample of brilliant play, publishing it in his "Principles," quoting it in his Essays, and telling us how and why J. Clay admired it, is altogether unsound,

* "Whist Developments," by Cavendish. Thos. De la Rue & Co., London.

as "Mogul" long since pointed out (see Game XXIV., in "How to Play Whist,")—the play which rendered the double grand coup necessary amounting really to a determined effort to throw the game away—there can be no question of "Cavendish's" present skill and experience in his own method of play. What we object to is the attempt to make fixed rules out of the multitudinous points of play which a fine player has to deal with in the actual game.

We say little about the chapters on the American leads. Players already know what these leads are, and are agreed that if we admit the desirability of always showing partner the length of the chief suit, Mr. Trist's system is a great improvement on the incomplete method of penultimate and ante-penultimate leads adopted before, and on the occasional use (only) of a method for showing at second or third round that five or more had originally been held in the suit. Our own belief is that this systematising of the rules for showing length has brought out more obviously than before the disadvantage of *always* showing length. It would be well, in our opinion, if the use of the methods for showing length should be regarded as indicating *more*,—viz., that there was a probability of bringing in the suit whose length was thus shown. With a weak hand, to display the exact length of a long weak suit is simply in nine cases out of ten to play the enemy's game.

However, the American leads so simplify the rules for showing ength, and therefore so suit the players who prefer a system they can follow easily to one which leaves them to decide for themselves, that we may regard them as almost sure to be generally adopted; and if so, they must be followed even by those who dislike them, or otherwise there will be risk of actually misleading partner. I will therefore only remark farther respecting them, that at New Orleans their birthplace, and at New York where they are much dmired, they are followed much more steadily than they are utilised. I doubt if a single American player except Mr. Trist himself, has once in a hundred games noted the meaning of cards played according to this system. Perhaps if a new system were adopted, by which each player should have a paper for noting the cards played to tricks, and time to enter all details, and to make all necessary calculations when his turn came to play, the system would work as Cavendish and Mr. Trist think it ought to work,—but as a matter of observed fact it does *not* work that way.

What we note as particularly objectionable in "Whist Developments" is the wooden series of rules laid down for what is called the "Plain-suit Echo." In the first place a case is cited from old Hoyle to show that he anticipated this modern device,—a case in which, in some mysterious way the third player is supposed to know that his partner holds a great suit when only two cards of that suit have been played, and holding Queen, Ten, Nine, and a very small one of that suit, third player retains the very small one and plays the Nine to his partner's Ace. The common sense of this is so obvious that it needs no insisting upon. You are supposed to know that your partner holds at least five, you yourself hold four, and one has fallen on your right; so only three cards lie with the enemy: it is almost certain therefore that if you retain three cards out of the five highest left, you will block your partner's great suit. Hoyle indeed definitely assigns six cards to your partner, so that you are absolutely certain to lose nothing by playing the Nine instead of the very small one, even if both King and Knave lie on your left. On the strength of such cases, Cavendish adopts as a general rule that when Ace is led, also in other cases definitely assigned, and you hold as third player exactly four cards of the suit, you should play the lowest but one. He takes no account of the fact that in many, nay in the great majority of cases, where you hold four cards exactly and your partner holds at least four but possibly more, there is no occasion to unblock at the first round, simply because there are two or more small cards among your four. Thus in the game in this week's *Field* (Aug. 22), which is intended specially to show the advantage of unblocking, the third player holds Ten, Eight, Six, and Two, and there is in reality no occasion whatever for playing the Six in preference to the Two. Amongst other points, left entirely unnoticed by Cavendish, is this, that when you know your partner can get in again, after you have taken your last trick in his suit, either by sure re-entering plain cards, or by long trumps, you need not trouble yourself about unblocking his suit. The play of third hand in such cases cannot possibly—at any rate cannot properly—be laid down to rule: it should depend entirely on judgment of the position. Of course, *more suo*, Cavendish rejoices more at being able to get out a new development than at any real advantage which the play according to his new rule may afford. It troubles him little that he is spoiling the game by knocking the brains out of it, that he is muddling the signal (insomuch that to signal our unlucky Cavendishian third player must play his lowest but *two*, and has not signalled f, giving up his plain suit echo at the second round, he plays the lowest; with other confusions), and that he is introducing a broad swarth of exceptions to the really important general rule. "Return the lowest of three": all this is a mere nothing compared with the introduction of "Another Whist Development."

Luckily there is a way in which those who have confidence enough to play according to their judgment of what is fitting, may neutralise the mischief of these weak developments; a player can let it be known,—First, that when he uses the American leads he means that he has a strong and well protected hand, as well as a suit of such and such a length; and secondly, that as partner he knows enough of the strategy of the game to determine, independently of any cut-and-dried rules, the propriety of unblocking his partner's suit, whether as third player or by discarding.

The way in which the illustrative games are given is very unsatisfactory, as in all Cavendish's works. There is nothing like the plan of the old *Westminster Papers*, of which ours is a development (improved, we think).

CONTENTS OF No. 199.

NOTICES.

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CONTENTS OF No. 201.

FINDING THE WAY AT SEA.

By RICHARD A. PROCTOR.

(*Continued from p.* 177.)

EVERYONE who makes a long sea-voyage must have noted the importance attached to noon observations; and many are misled into the supposition that these observations are directly intended for the determination of the longitude (or, which is the same thing in effect, for determining true ship-time). This, however, is a mistake. The latitude can be determined at noon, as we have seen. A rough approximation to the local time can be obtained, and is commonly obtained, by noting when the sun begins to dip after reaching the highest part of his course above the horizon. But this is necessarily *only* a rough approximation, and quite unsuited for determining the ship's longitude. For the sun's elevation changes very slowly at noon, and no dip can be certainly recognised even from *terra firma*, far less from a ship, within a few minutes of true noon. A determination of time effected in this way, serves very well for the ship's "watches," and accordingly when the sun, so observed, begins to dip, they strike "eight bells" and "make it noon." But it would be a serious matter for the crew if that was made the noon for working the ship's place; for an error of many miles would be inevitable.

The following passage from "Foul Play," illustrates the way in which mistakes have arisen on this point. The hero, who being a clergyman and a university man is of course a master of every branch of science, is about to distinguish himself before the heroine by working out the position of the ship *Proserpine*, whose captain is senselessly drunk. After ten days' murky weather "the sky suddenly cleared, and a rare opportunity occurred to take an observation. Hazel suggested to Wylie, the mate, the propriety of taking advantage of the moment, as the fog bank out of which they had just emerged would soon envelop them again, and they had not more than an hour or so of such observation available. The man gave a shuffling answer. So Hazel sought the captain in his cabin. He found him in bed. He was dead drunk. On a shelf lay the instruments. These Hazel took and then looked round for the chronometers. They were safely locked in their cases. He carried the instruments on deck, together with a book of tables, and quietly began to make preparations, at which Wylie, arresting his walk, gazed with utter astonishment" (as well he might).

"'Now, Mr. Wylie, I want the key of the chronometer cases.'

"'Here is a chronometer, Mr. Hazel,' said Helen, very innocently, 'if that is all you want.'

"Hazel smiled, and explained that a ship's clock is made to keep the most exact time; that he did not require the time of the spot where they were, but Greenwich time. He took the watch, however. It was a large one for a lady to carry, but it was one of Frodsham's masterpieces.

"'Why, Miss Rolleston,' said he, 'this watch must be two hours slow. It marks ten o'clock; it is now nearly midday. Ah, I see,' he added with a smile, 'you have wound it regularly every day, but you have forgotten to set it daily. Indeed, you may be right; it would be a useless trouble, since we change our longitude hourly. Well, let us suppose that this watch shows the exact time at Sydney, as I presume it does: I can work the ship's reckoning from that meridian, instead of that of Greenwich.' And he set about doing it. Wylie, after some angry words with Hazel, brings the chronometers and the charts. Hazel 'verified Miss Rolleston's chronometer, and allowing for difference of time, found it to be accurate. He returned it to her, and proceeded to work on the chart. The men looked on; so did Wylie. After a few moments, Hazel read as follows: West longitude 146° 53′ 18″, South latitude 35° 24′. The island of Opara* and the Four Crowns distant 420 miles on the N.N.E.' and so on. And, of course, 'Miss Rolleston fixed her large soft eyes on the young clergyman with the undisguised admiration a woman is apt to feel for what she does not understand."

The scene here described corresponds pretty closely, I have little doubt, with one actually witnessed by the novelist, except only that the captain or chief officer made the observations, and that either there had not been ten days' murky weather or else that in the forenoon, several hours at least before noon, an observation of the sun had been made. The noon observation would give the latitude, and combined with a forenoon observation, would give the longitude; but *alone* would be practically useless for that purpose. It is curious that the novelist sets the longitude as assigned much more closely than the latitude, and the value given would imply that the ship's time was known within less than a second. This would in any case be impracticable; but from noon observations the time could not be learned within a minute at the least. The real fact is, that to determine true time, the seaman selects, not noon, as is commonly supposed, but a time when the sun is nearly due east, or due west. For then the sun's elevation changes most rapidly, and so gives the surest means of determining the time. The reader can easily see the *rationale* of this, by considering the case of an ordinary clock-hand. Suppose our only means of telling the time was by noting how high the end of the minute-hand was; then clearly we should be apt to make a greater

* The island fixes the longitude at about 147°, otherwise I should have thought the 4 was a misprint for 7. In longitude 177° west, Sydney time would be about 2 hours slow, but about 4 hours slow in longitude 147° west.

mistake in estimating the time when the hand was near XII. than at any other time, because then its end changes very slowly in height, and a minute more or less makes very little difference. On the contrary, when the hand was near III. and IX., we could in a very few seconds note any change in the height of its extremity. In one case we could not tell the time within a minute or two; in the other we could tell it within a few seconds.

But the noon observation would be wanted to complete the determination of the longitude; for until the latitude was known, the captain could not be aware what apparent path the sun was describing in the heavens, and, therefore, would not know the time corresponding to any particular solar observation. So that a passenger, curious in watching the captain's work, would be apt to infer that the noon observations gave the longitude, since he would perceive that from them the captain worked out both the longitude and the latitude.

It is curious that another and critical portion of the same entertaining novel, is affected by the mistakes of the novelist on this subject. After the scuttling of the *Proserpine*, and other events, Hazel and Miss Rolleston are alone on an island in the Pacific. Hazel seeks to determine their position, as one step towards escape. Now, "you must know that Hazel, as he lay on his back in the boat, had often in a half-drowsy way, watched the effect of the sun upon the boat's mast: it now stood, a bare pole, and at certain hours acted like the needle of a dial, by casting a shadow on the sands. Above all, he could see pretty well, by means of this pole and its shadow, when the sun attained its greatest elevation. He now asked Miss Rolleston to assist him in making this observation exactly. She obeyed his instructions, and the moment the shadow reached its highest angle and showed the minutest symptom of declension,* she said 'Now,' and Hazel called out in a loud voice" (a soft voice would have served as well) "'Noon!' 'And forty-nine minutes past eight at Sydney,' said Helen, holding out her chronometer; for she had been sharp enough to get it ready of her own accord. Hazel looked at her and at the watch with amazement and incredulity. 'What?' said he, 'Impossible. You can't have kept Sydney time all this while.' 'And pray why not?' said Helen. 'Have you forgotten that some one praised me for keeping Sydney time? it helped you, somehow or other, to know where we were.'" After some discussion, in which she shows how natural it was that she should have wound up her watch every night, even when "neither of them expected to see the morning," she asks to be praised. "'Praised!' cried Hazel, excitedly, 'worshipped, you mean. Why, we have got the longitude by means of your chronometer. It is wonderful! It is providential. It is the finger of Heaven. Pen and ink, and let me work it out.'" He was "soon busy calculating the longitude of Godsend Island." What follows is even more curiously erroneous. "'There,' said he. 'Now the latitude I must guess at by certain combinations. In the first place, the slight variation in the length of the days. Then I must try and make a rough calculation of the sun's parallax.'" (It would have been equally to the purpose to have calculated how many cows' tails would reach to the moon.) "'And then my botany will help me a little; spices furnish a clue; there are one or two that will not grow outside the tropic,'" and so on. He finally sets the latitude between the 26th and 33rd parallels, a range of nearly 500 miles. The longitude, however, which is much more closely assigned, is wrong altogether, being set at 103½ degrees *west*, as the rest of the story requires. For Godsend Island is within not many days' sail of Valparaiso. The mistake has probably arisen from setting Sydney in *west* longitude instead of *east* longitude, 151° 14'; for the difference of time, 3h. 11m., corresponds within a minute to the difference of longitude between 151° 14' west and 103½° west. The whole account is crowded with mistakes.

Mere mistakes of calculation, however, matter little in such cases. They do not affect the interest of a story even in such extreme cases as in "Ivanhoe," where a full century is dropped (in such sort that one of Richard the First's knights holds converse with a contemporary of the Conqueror, who, if my memory deceives me not, was Cœur de-Lion's great-great-grandfather). It is a pity, however, that a novelist, or indeed any writer, should attempt to sketch scientific *methods* with which he is not familiar. No discredit can attach to any person, not an astronomer, who does not understand the astronomical processes for determining latitude and longitude, any more than to one who, not being a lawyer, is unfamiliar with the rules of Conveyancing. But when an attempt is made by a writer of fiction to give an exact description of any technical matter, it is as well to secure correctness by submitting the description to some friend acquainted with the principles of the subject. For, singularly enough, people pay much more attention to these descriptions when met with in novels than when given in text-books of science, and they thus come to remember thoroughly well precisely what they ought to forget. I think, for instance, that it may not improbably have been some recollection of "Foul Play" which led Mr. Lockyer to make the surprising statement that longitude is determined at sea by comparing chronometer time with local time, which is found "at noon by observing, with the aid of a sextant, when the sun is at the highest point of its path." Our novelists really must not lead the student of astronomy astray in this manner.

(To be continued.)

* This would be a most difficult matter to determine: Hazel should have taken the task himself (even he would have made nothing out of it, though Mr. Reade makes so little of it): he might safely have left Miss Rolleston to call out "Noon" for him when he had noted it.

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

XVI.—BOOTS AND SHOES.

I NOW approach a very difficult part of my subject; the philosophy of foot clothing. The question of whether we should clothe the feet at all, even in these and higher latitudes is fairly debateable. Our ordinary devices for imprisoning, strangling, cramping, and suffocating them are demonstrably abominable, but how we are to proceed in carrying out the much-needed boot and shoe reform is not easily decided.

Let us examine the structure and functions of the foot, and then ask ourselves whether we are obeying or disobeying the injunctions which these express, whether our boots and shoes—especially boots—are assisting or hindering the performance of the natural functions of the feet.

Beginning with the skeleton of the human foot. The first fact that presents itself is that it is built up of a

number of small bones—no less than twenty-six. Even the most solid part of the foot, from the heel to the instep, that upon which the ankle rests, is in seven pieces, and there are five more in front of these before the toe bones are reached. These twelve bones form an arch upon which the whole of the body rests, and this arch is specially constructed to combine firmness with elastic spring, and in the forward or toe-part of the foot the fourteen bones, with their muscles, tendons, and ligaments, we find arrangements for considerable flexibility. None of the bones of the foot directly touch each other as bones; the junctions of all are lined with cartilaginous matter, preventing vibratory jar.

A very important function, but little understood, of this complexity is to enable the foot to co-operate with the other buffers of the body in protecting the brain from concussion. In running and jumping, a mass weighing from 150 to 250 lb. is repeatedly falling to the ground, and striking it with considerable violence. If it were a rigid mass, a vibratory shock would travel through it up to the skull at each collision with the ground, and such a shock would seriously damage the brain, arresting, or more or less completely stopping, the mental functions. But we are protected against such vibratory shock—first, by the structure of the skull, which is made up of several pieces, and thus cannot vibrate as a whole; by the thick, elastic cartilages that lie between each of the twenty-four pieces of the spine; then by the cartilages of the hip and thigh-bones; by other cartilages in the knee-joints; and finally, by those of the ankle and the complex mechanism of the foot already described. As the maximum weight rests on the foot, its elastic response is primary and important.

It is evident that a tight boot made of material yielding so little as thick leather, must cripple and frustrate the functions of this beautiful and beneficent mechanism. This is shown by the tottering steps of a tightly-booted human being. The tottering step of old age is largely due to the decay, the withering or drying up of and consolidating of the springs above described; but a young man or woman, or even a boy or girl, may be, in this respect, brought prematurely to a condition of old age by tight boots. This description applies not only to the torture-chambers of imbeciles who intentionally squeeze their feet in order to make them appear unnaturally small, but to ordinary average boots, such as an average boot-maker supplies when they are "made to measure." In order to obtain a respectably fitting boot or shoe I have found it necessary to wear two or three pairs of thick woollen socks one over the other when going to be measured. A conventional fit for this enlarged foot becomes a decent fit for the actual foot.

According to the natural structure of human toes, they should spread out with space between each other, forming the widest part of the foot when it is planted on the ground. They should also, by virtue of the muscles attached to them, exert some prehensile power in climbing, and in the final projecting effort of running. The victims of ordinary boots inherit degenerate feet, in which these functions are practically annulled, and before they attain middle age the large toe is actually turned inwards, and all the toes squeezed together. The naked foot of a full-grown fine lady is usually a very disgusting object; that of an infant or a Highland lassie is very beautiful.

The supply of sweat glands is area for area—more abundant on the hands than on any other part of the body, and next to the hands, the feet are the best supplied. The lesson we should learn from this is obvious enough. Both hands and feet should be specially free to perform their natural functions of superabundant exhalation. The wearing of leather gloves, merely for appearance sake, should be denounced as contemptible foppery. Protection of the hands from cold, from dirt in exceptional cases, or from mechanical injury, as in trimming thorn hedges, &c., is, of course, a full justification of the practice; but the housemaids' gloves, gardeners' gloves, driving gloves, &c., are very different from the finger-pinching hand-prisons of the fop. I have heard of women who have reduced themselves to such a condition that they are liable to take cold if their hands are wetted by water of ordinary temperature. Poor things!

But what shall we say of the condition of ordinary average conventional feet? What a satire upon our ordinary practice of foot-clothing is the almost universal dread of wet feet! The human foot, with its special sole integument, is specially constructed for exposure to cold and wet ground: and, when it has not been artificially injured by false imprisonment, no inconvenience follows its free exposure to rain-sodden or snow-covered ground during the course of ordinary locomotion. Young ladies in English boarding-schools are martyrs to chilblains. Highland girls, who walk bare-footed to school through frost and snow, and rain and sleet, rarely know what such things mean, and the slight acquaintance they have is of recent origin, since their partial adoption of southern foot-gear.

I have no hesitation in positively affirming that whoever is liable to take cold by temporarily wetting the feet has diseased feet. This form of disease very frequently reaches the stage of putrescence of the perspiration of the feet. We hear of many remedies for this, and of their failures, but there is one that will not fail if persistently applied, that is, continuing bare-footed and usually wet-footed. I know that it is not easy—in most cases practically impossible—to apply this fully, and caution should, of course, be used at first, but if every available opportunity were used of absolutely uncovering the feet, and at all other times wearing the most loose and porous shoes or slippers, with soft, absorbent woollen socks, great relief would be afforded.

If there was no such things as tin-tacks, pins and needles, broken glass and crockery, I should be disposed to advocate the total abolition of boots, shoes and stockings, and the furnishing of all street-doors with water-troughs and towel-mats for the use of entering inmates and visitors. Natural asperities of ground (barring thorns), are easily overcome by the remarkable facility with which the sole of the foot thickens when exposed to mechanical irritation. It is a fact not generally observed that this hard integumentary structure extends not only over the bottom of the foot, but to a considerable extent up its sides, especially at the heel. I regard corns as plaintive protests made by tortured feet against the ill-usage they receive. A corn is a local demonstration of the natural thickening capabilities of the skin of the foot on the application of suitable stimulants. If the whole of the working surface were properly exposed, such callosity would extend throughout, and would be protective instead of painful. The corn is a thorn in the flesh, a local spear-like hardening, that penetrates the surrounding tenderness instead of covering and protecting it.

My first experience in barefoot walking dates as far back as 1841. In the autumn of that year I was at the Athol Gathering, then a genuine Highland festival of the peasantry (subsequently a fashionable aristocratic assembly). On the morning after the ball at the Brig of Tilt, where I was the only trousered Sassenach, I started

to walk to Braemar through Glen Tilt, and was overtaken by a Highland lassie, a beautiful specimen of a noble race. She had been the belle of the ball, and was engaged to its hero, a stalwart Cameron, who had carried off all the best prizes at the athletic competition. We walked on together, but though an able pedestrian, I had a struggle to keep pace with my vigorous barefooted companion. Observing this, she suggested that I should cast off my shoon and be free. I did so, and the ground being favourable for a beginner, perceived at once that my natural pace became the same as hers without the forcing or strain that was previously necessary. In the course of many thousands of miles of subsequent pedestrian excursions I have frequently done the like with similar advantage, though unable to continue a long distance on account of the tenderness of artificially-swaddled soles. Crossing a sandy bay at low tide is very tempting, and if the sands are hard a curious result follows a long walk. After a few miles a slight tenderness is felt in the ball of the large toe. This increases, and presently becomes painful. On examination, the cuticle of that part is found to be ground smoothly away by the friction on the sand. My first experience of this was in crossing one of the fine bays near the Giant's Causeway. Unconscious of what was going on I persevered until the pain grew serious, and then found that the cutis was bared. The next day I was unable to walk at all. I name this as a warning to others who may be induced to try experiments in barefoot walking.

When bare feet are objectionably conspicuous, or the ground severe, I walk on for an hour or two in orthodox fashion, then stand ankle deep in a brook; or pour water in my shoes, and keep my feet scrupulously wet during the rest of the day. This adds about 20 per cent. to the possible mileage. One consequence of this, and the habit of usually wearing very loose slippers, is that, though no longer a boy, I laugh at the idea of suffering any evil consequences from wet feet, whether walking, standing, or sitting.

OPTICAL RECREATIONS.

BY "A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY."

(*Continued from Page* 541 *of Vol. VII.*)

"IF," says Sir David Brewster in his *Optics*, "We transmit a beam of the sun's light through a circular aperture into a dark room, and if we reflect it from any crystallised or uncrystallised body, or transmit it through a thin plate of either of them, it will be reflected and transmitted in the very same manner, and with the same intensity, whether the surface of the body is held above or below the beam, or on the right side or left, or on any other side of it, provided that in all these cases it falls upon the surface in the same manner; or, what amounts to the same thing, the beam of solar light has the same properties on all its sides; and this is true, whether it is white light or directly emitted from the sun, or whether it is red light, or light of any other colour. The same property belongs to light emitted from a candle or self-luminous body, and all such light is called *common* light."

Now we have previously seen in the course of these Essays (Vol. V., p. 352, *et alibi*) that light consists of a series of undulations or vibrations transverse to the direction in which it is propagated, and it is pretty evident that these vibrations must occur symmetrically as regards the axis of the beam. Let us suppose that in Fig. 44 the left-hand circle represents a section of a beam of light coming through a small round hole into a darkened room, then will the vibrations of which it is

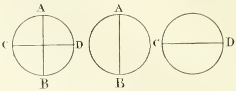


Fig. 44.

made up be performed in the direction C D, as well as in that A B. Or possibly an extremely simple model, which the reader may make at once, will render our meaning a little clearer. Let him, then, get a piece of card, and with a penknife cut out two undulating strips like V^1 (Fig. 45). A horizontal slit in one of them will

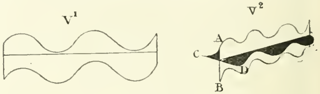


Fig. 45.

enable the other to be inserted through it at right angles, and we shall obtain the V^2 of the same figure, which will represent our symmetrical beam of light—symmetrical because it is obviously alike in every direction. Is it possible in any way to alter this disposition of the vibrations of the ether, and so obtain a beam with *sides?* Let us see. Many of our London readers must recollect the shop of the late Professor Tennant in the Strand, and the splendid rhomb of Iceland spar which used to be exhibited in the window, showing a double image of a red wafer placed behind it. A description of this will form an introduction to the study of the so-called "polarisation of light," to which we are now about to address ourselves. A rhomb, as most people are aware, is a solid bounded by six equal and similar rhomboids—a rhomboid being defined by Euclid (Definition XXXIII.) as having "its opposite sides equal to each other; but all its sides are not equal, nor its angles right angles." Well, whether we find Iceland spar in a crystalline or massive condition it will always split up into rhombs, like Fig. 46.

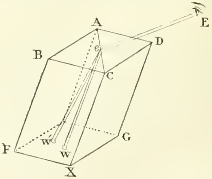


Fig. 46.

The opposite sides of a crystal of this sort are parallel, and the line AX (known as the axis of the crystal) is equally inclined to all its six faces at an angle of 45° 23′. Suppose now that we obtain such a crystal (the larger it

is the better, and at all events the length of one of its edges must be at least an inch), and making a circular dot, W, on a sheet of paper, place one face of the crystal on it. Then, to an eye placed at E, the dot will be seen double, as W, W^1, and if we turn the crystal round, the same side always touching the paper, we shall see the dot W remain apparently stationary, and the dot W^1 describe a seeming orbit round it. Now we have several times insisted, in these papers, on the fact that light goes and returns by the same route, and hence the reader will be prepared to expect that if instead of viewing a spot from E we there place a source of light, the beam E*e* will be split on entering the crystal, and its image be seen as two to an eye placed on the other side of what was the base of our crystal in our first experiment. Moreover, when we come to investigate the bending of this double ray, we shall find that while *e*W follows the ordinary law of sines (vol. vi., p. 32), and lies, of course, in the plane of incidence, *e*W^1 does nothing at all of the sort, but follows some new and remarkable law. Hence *e*W is called the ordinary ray, and *e*W^1 the extraordinary ray. It may not, perhaps, be wholly out of place to add here that when the ray E*e* is incident perpendicularly on the face A B C D, as in other cases, the *ordinary ray* passes straight through the crystal, and is not refracted at all, while the extraordinary ray, under these circumstances, has an angle of refraction of 6° 12′, and is bent on one side. Lastly, we may note that a ray of light passing in the direction A X suffers no double refraction whatever.

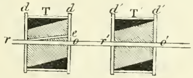


Fig. 47.

Now we have gone into all this seemingly irrelevant detail, because in splitting the incident beam of light into two our crystal has done something else: in point of fact it has separated our original beam A B C D (Fig. 44) into two, A B and C D, each having different properties on different sides; or rather, A B has the same properties at its sides A and B that C D has at its sides C and D. In other words, the vibrations of which the beam of common light A B C D is made up have been split into two separate sets A B and C D at right angles to each other. Each, then, of these separate beams is said to be polarised, and the planes passing through the lines A B and C D are called the planes of polarisation of the beams respectively. From this we may infer, what we shall find experimentally to be the fact, that a beam of common light A B C D may be regarded as made up of two beams of polarised light with their planes of polarisation at right angles to each other; and that if we superposed these polarised beams so that their planes of polarisation, instead of being at right angles, were made coincident, we should get a beam of polarised light twice as luminous as either of the separate beams composing it. We have only to employ a second rhomb of Iceland spar to show this.

For this purpose it is better to mount our two rhombs of spar, as shown in Fig. 47, where T and T′ show two pieces of brass tube in which our rhombs are fastened by means of cork rings. Both ends of the tubes are covered by brass discs *d d d′ d′*, perforated centrally with holes. Placing our tubes, then, in a horizontal position, and letting a beam of parallel solar rays *r o* pass through the left hand opening, it will be seen, from what has preceded, that only the ordinary ray *r o* will emerge through the opposite hole, the extraordinary ray *r e* being refracted up to *e*, whence, of course, its egress is prevented by the solid brass plate. If now the two rhombs are so situated that their principal planes passing through *r o* and the optic axis lie in the same plane (say that of the paper), the ordinarily refracted ray *r o* will pass similarly through the second crystal, as at *r′ o′*. If, though, keeping the first tube fixed, we rotate the second one about its axis, we shall find that double refraction will take place, and that an extraordinary as well as an ordinarily refracted spot of light will become visible. This extraordinarily refracted ray, at first dim, becomes brighter as the crystal is rotated, the ordinary ray diminishing correspondingly in illumination until the angle between the two principal planes of cleavage of the rhombs = 45°. As the rotation continues, the ordinary ray continues to fade out and the extraordinary ray to become stronger until, when the principal planes are square to each other, the ordinary ray vanishes, and the extraordinary one remains of the full strength of the original beam *o r*. Light may also conveniently be polarised by the aid of slices of the mineral tourmaline, cut parallel to the optic axis of the crystal. Tourmaline of moderate thickness entirely extinguishes the ordinary ray, but transmits the extraordinary ray (which vibrates parallel to its crystalline axis) perfectly. Tourmaline is of all sorts of colours, some splendid specimens from Devonshire being of so dark a brown as to appear almost black. If slices of sufficient thinness can be cut from

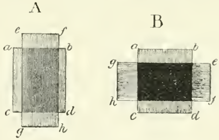


Fig. 48.

these dark crystals, they are generally effective, but this is no easy matter. Those usually found in commerce are brown, green or red. They, of course, colour the light to a certain extent if they are of a dark tint or cut into thick slices, but this is no great practical disadvantage. Two such plates mounted in cells which can be rotated, the cells being borne at the ends of a twisted wire, are sold by opticians under the name of "Tourmaline tongs." Any object required to be viewed by polarised light may be nipped between the wire rings in which the cells rotate. If now we place our two plates in such a position that their axes are parallel, as at A (Fig. 48). The light from the sun or any other source will pass through them just as it would through a single plate of the thickness of the two combined. If, though, we rotate one of the plates, as at B, the transmitted light will get weaker and weaker until, at length, when their axes are at right angles, it will disappear wholly, and darkness will supervene. And this seems a favourable point at which to pause in our description of Polarising apparatus, and to utilise the experiment just described in an endeavour to make the theory of polarisation apprehensible. To this end we may regard the internal structure of one of our plates as being that of a *grating*, with its parallel

openings vertical. If now we imagine our model of a beam of ordinary light, V^2, Fig. 45, to be pushed ("end on," as sailors say) against such a grating it is abundantly evident that, while the vertical series of vibrations, A B, would pass through perfectly, the transverse ones, C D, would be most effectually stopped: just as a walking-stick, held parallel to some iron railings, could be passed easily between them, but would be arrested at once if held across the direction of their length. At A, in Fig. 48, the, so to speak, cross vibrations C D, Figs. 44 and 45, have been shut out by the first plate, *a b c d*, and only the vertical ones, A B (same figs.) allowed to pass; and as our hypothetical "grating" is also vertical in the second plate, *e f g h*, the vertical undulations will get through that perfectly. But (B, Fig. 48) as the vibrations which pass through *a b c d* are all vertical, and vertical only, when we make our second supposititious grating, *e f g h*, horizontal, of course we interpose an insuperable barrier to their passage, and darkness is the result.

(To be continued.)

THE YOUNG ELECTRICIAN.

BY W. SLINGO.

(Continued from p. 158.)

ELECTROSCOPES.

PR. 6.—Electroscopes are instruments for detecting the presence of a charge of static electricity, and for determining its quality. They are of a simple nature, and exhibit important and interesting phenomena, but they must not be confounded with electrometers or instruments for measuring the strength or quantity of a charge. Induction is the ruling principle in the construction and action of electroscopes.

Ex. CIV.—Anything which will indicate the presence of electricity (such as a suspended feather, pith-ball, &c.) is in a measure an electroscope; but we will confine ourselves to such instruments as respond to the more complete definition. Fig. 58 illustrates a typical form of instrument. It consists of a bottomless gas-receiver or glass-jar, F, in the neck of which is a hard-wood stopper or cover, D, cemented on with sealing-wax, &c., and through a hole in the centre of which is a glass or other insulating tube, C. Through C passes a brass rod, B, secured to a brass plate (or ball), A, at the top, the lower extremity being flattened out or attached to a flat cross-piece of metal, E. On to the sides of E gold-leaves or pieces of Dutch metal, L L, are gummed, or otherwise attached.

Ex. CV.—A somewhat more elaborate instrument is shown in Fig. 59, in which A is the plate, B the insulated rod, and L L the leaves. In addition a metal shield, G, is fitted to the upper portion of the glass jar. It is insulated from the rod and plate A, but is connected to the earth or some other conductor in connection with it. Two strips of tinfoil, K K, are gummed or pasted on the inner surface of the jar, reaching at least high enough for the leaves, L L, to touch them instead of the glass (in the event of their being so far separated). These strips are also connected to earth. A small glass tray, H, of any convenient shape or dimensions is laid on the wooden base, W, and is supplied with a few small pieces of pumice-stone saturated with sulphuric acid, the function of which is to absorb any atmospheric moisture that may be present.

Ex. CVI.—A form frequently recommended for amateurs or beginners is that illustrated in Fig. 60, where F is a glass flask, which has been thoroughly dried and warmed, and in the neck of which is a sound cork or vulcanite stopper, C, through which is passed a wire, W, the upper part of which is soldered to a small disc, T, the lower part, W', being bent at right angles to carry the leaves, L L.

Ex. CVII.—For our present purpose I have not a great opinion of either of these pieces of apparatus. They are one and all more costly or more elaborate than is necessary. The object of the glass jar or flask is simply to protect the leaves from air-currents, and prevent their being affected by atmospheric moisture. If we could get a transparent metallic jar, nothing could suit our purpose better, but that, of course, is out of the question. Let us study Fig. 58 and its teachings a little, and we shall then see what is actually required. Suppose an electrified rod, say of glass, to be brought near the plate A. Induction takes place, A becoming negatively, and the leaves L L positively, charged. L L, in consequence of their similar charges, mutually repel, and, instead of hanging vertically, take up positions more or less resembling those illustrated, the amount of divergence

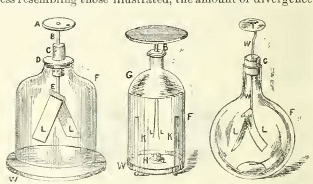


Fig. 58. Fig. 59. Fig. 60.

in any particular instrument depending naturally upon the charge. On the electrified rod being withdrawn, the leaves fall together, exhibiting no signs of electrification, the equal charges produced at A and L L combining and producing neutrality again. Let the rod be once more brought towards A, and the electroscope re-charged; then (the position of the rod being unaltered) let the finger touch B, or any part of A not immediately opposite the rod. The leaves will fall together consequent on the positive electricity repelled to them being neutralised by the earth-contact through the finger. As a matter of fact, the state of affairs is somewhat akin to a huge conductor, of which one extremity is at A and the other at some antipodean point.

Remove the finger. No change takes place in the position of the leaves. Subsequently remove the glass rod and the leaves diverge: this time with negative electricity, because the removal of the rod "sets free" the negative charge concentrated at A, some of which charge finding its way to the leaves causes the divergence. A finger placed on A neutralises this negative charge. Suppose the finger not to be so placed, then we have a charge of electricity in the leaves whose quality (positive or negative) we know, because we first used a body provided with a known charge.

To determine the quality of another charge all that is necessary is to place the body carrying the charge near A, and inducing a further charge in the metallic system A L. If the unknown charge is negative, a positive

charge collects at A, and additional negative is driven into the leaves, whence the previously existing divergence is increased. An increased divergence then proves that the unknown charge is similar to the known charge in the leaves. The falling together (or collapse) of the leaves may indicate an opposite (in this case positive) charge on the body being tested, but there is a little chance of our being deceived in this case, as the approach of a neutral body might produce a like effect, for the charge in the leaves would speed to the assistance of the similar charge on A in its efforts to electrify the previously unelectrified or neutral rod. This may be proved by bringing the hand near A.

With a ball or plate at A (instead of a metallic point, or the end of the wire) the charge on the leaves may be retained for a considerable time, but this advantage is lost if there are any points on the metallic system, or if the air confined in the jar has not been thoroughly dried. The necessity for dry warm air is apparent. There is some danger that, in the event of the charge on the rod under examination being exceptionally strong, the leaves will be made to take up positions so far divergent that they enter into contact with the surface of the glass. Now, the presence of a charge at L L indicates the ability to induce a charge on the surface of F. This certainly takes place when mutual attraction between this charge and that on L L sets in. If the surface of F is but a poor conductor, the leaves are liable to stick. This is overcome by gumming or pasting two strips of tinfoil on the inside of the glass, as K K (Fig. 59), and placing them in connection with the earth. The charge upon L L readily produces an opposite charge upon K K, the similar charge pushing its way into the earth. The divergence of L L is accordingly increased, and possibly L L comes into contact with K K, in which case neutralisation immediately ensues, and the leaves fall together uninjured. The metallic shield, G (Fig. 59), is to prevent the electrified rod exerting any direct inductive effect upon L L. The function of the sulphuric acid, with which the pumice-stone in H is saturated, is to absorb any atmospheric vapour that may be present.

The objections to the form depicted in Fig. 60 are apparent. In the first place, no tin-foil strips can be utilised, and, in the second place, it is impossible to remove any atmospheric moisture, dirt, &c., which may have been left behind in sealing up. We will next turn our attention to an instrument the cost of the materials for which shall not exceed threepence, but which, nevertheless, will answer our every purpose.

THE GREAT RED SPOT ON JUPITER.

By Richard A. Proctor.

(*Continued from p.* 157.)

Let us look into this matter a little more closely: and first, let us ask if anything akin to the difficulty thus recognised in the case of Jupiter (and also in that of Saturn) exists elsewhere.

Now in the case of the sun we have an orb which is probably in large part gaseous. We certainly have, *visibly*, a gaseous region thousands of miles in depth, even estimating the depth only from the visible surface of luminous cloud which we call the photosphere. And in the sun's case the attraction of gravity on the atmospheric region thus recognised, is ten or twelve times greater than the attraction on the atmosphere of Jupiter. Therefore we have in the sun's case a much greater difficulty than in the case of Jupiter or Saturn.

It is true that the intense heat pervading the whole frame of the sun suggests a way of meeting the difficulty which does not at first sight seem available in dealing with the giant planets. The laws which connect density and pressure at ordinary temperatures and at ordinary pressures may probably fail altogether where the temperatures are so high and the pressures so enormous as they must be throughout the whole frame of the sun. We may say, indeed, as I have elsewhere shown, respecting the outer parts of the sun we see, what Professor Young said of the usually unseen corona, that if the term atmosphere be understood as we understand it when speaking of our own air, the gaseous regions forming the parts of the sun next within the photosphere do not form an atmosphere at all. Here are his remarks in regard to the corona, each one of them being fully applicable to the gaseous envelopes within the visible surface of the sun:—"Granting for the moment that the corona is in part and largely composed of an envelope of exceedingly rare gaseous matter around the sun,—then we may call it an atmosphere, because being gaseous and attached to a cosmical body, it bears to that body a relation analogous to that borne by our atmosphere to the earth itself. So far the term is a proper one. But now further, and on the contrary, the term 'atmosphere' carries with it to most persons certain ideas as to the distribution of temperature, density, &c., in its different parts, which are based on the fact that our terrestrial atmosphere is nearly quiescent and in static equilibrium under the force of gravity, with a temperature not more than two or three hundred degrees above the absolute zero, while the density of the portion accessible to human observation is very considerable. On the sun the conditions are immensely, and almost inconceivably different, so that the term 'atmosphere' becomes a very misleading one. There the equilibrium, so far as there is any, is dynamical, not statical, and the density, temperature, and condition of the gaseous substance is far more nearly that of the residual gas in a Crookes's vacuum tube through which an induction coil is sending electrical discharges; so different from that of ordinary air that Crookes thought he had found a fourth state of matter, bearing some such relation to the gaseous state as the gaseous does to the liquid."

That this is so in regard to the sun is shown at once if we remember that the great openings we call spots disclose solar regions lying certainly not less than 10,000 miles below the sun's visible surface. Now the strength and breadth of the hydrogen lines seen in the spectrum of the sun's coloured flames show that the hydrogen present there is not indefinitely rarer than hydrogen at the pressure of the air we breathe. Putting the pressure at the sun's visible surface at the millionth part of the atmospheric pressure on earth at the sea-level, and noting that gravity at the sun's visible surface is 27 times gravity at the earth's, we find that at a depth of two or three miles below the sun's apparent surface atmospheric pressure would be the same as at our sea-level were the same gases present, and temperature the same there as here. For in about the eighth of a mile the pressure would double, so that in $2\frac{1}{2}$ miles there would be twenty doublings of pressure, raising the density from the millionth part of our air's to somewhat more than equality with the density of our air (2 doubled, that double doubled, and so on, to 20 doublings, giving 1,048,576). In the next $2\frac{1}{2}$ miles the pressure would be increased more than a millionfold,— always assuming

the conditions to hold which we recognise in our own atmosphere. This would happen in five miles out of 10,000 miles of depth, known to be occupied by gaseous matter.

Even taking into account the tremendous heat prevailing in the sun, and the existence of much lighter gases in his surroundings than exist in our own air, we cannot escape conclusions scarcely less preposterous and assuredly quite as inadmissible as we have thus reached. If the pressure and density did not double in less than a mile, or than ten miles, or even a hundred,—which is altogether impossible—we should still have, within a range of 10,000 miles, 10,000, or a 1,000, or a 100 doublings (in these cases respectively); and consequently even with the least of these numbers there would be a density at the base of the 10,000 miles exceeding a billion billion times * the density of our own air.

Undoubtedly it is not in the high temperature of gases near the sun, or not in this only, that the solution of the enigma lies. We have also to take into account the freedom of movement which exists throughout the gaseous envelopes of the sun, and the constant movements which are no doubt taking place within these envelopes.

In some such way, I think, we must encounter the difficulty, kindred in character if not so great in degree, which exists in Jupiter's case. We must admit the existence of intense heat throughout the gaseous surroundings of Jupiter, though we need not imagine that they are as hot as the gaseous envelopes of the sun, or that their temperature ever approaches solar temperatures. We must admit great freedom of motion within these gaseous and vaporous regions around Jupiter. So may we at once escape the difficulty which Jupiter assuredly presents, and be led to the conclusion which we had already reached from another side,—viz., that Jupiter's outer portions to a depth of many hundreds of miles within his visible surface do not belong to his real globe, but are mainly formed of gaseous, vaporous, and cloud-like matter.

From yet other directions the same result has been reached, as I pointed out in my "Other Worlds than Ours," many years before the great spot had appeared. No one now supposes that Jupiter is made of other materials than those which form the earth on which we live, nor does any one now suppose that Jupiter is a hollow planet as Sir David Brewster insisted. Yet if we do not adopt one view or the other we cannot possibly explain the small mean density of Jupiter otherwise than by assuming that the globe we measure for Jupiter is very much larger than the planet itself. Jupiter is 1,250 times as large as the earth, but only 310 times as massive. This, alone, proves that the real globe of Jupiter lies far within the cloud-strewn surface we measure. With the enormous attraction residing in 310 times the earth's mass, a globe of the same materials as our earth would be considerably denser instead of less dense than the earth. Assigning to Jupiter a density only equal to the earth's its diameter would be little more than 50,000 miles. Jupiter's diameter is fully 80,000 miles. The distance of the cloud-strewn surface we see, from the real surface of the planet, cannot then, it would seem, be less than 15,000 miles (the difference between 40,000 miles and 25,000 miles, the halves of the just-named diameters).

The telescopic aspect of Jupiter corresponds much better with this startling result than with the idea that he has an atmosphere in the least resembling our earth's.

* In the first twenty doublings equality with our atmospheric pressure would be attained, in the next twenty the pressure would be a million times greater, in the next a billion times, in the fourth twenty doublings the pressure would be a trillion times, and in the last twenty it would be raised to a quadrillion times the pressure at our sea-level. (I use the English system of numeration according to which a million raised to the second power is a billion, to the third power a trillion, to the fourth a quadrillion, and so forth.)

BAUDRÉ'S SILEX PIANO.

AMONG the flint stones that are met with in the chalk formation there are some that when struck with another flint emit sounds of great purity. The tones that are thus obtained with different musical flints are out of all proportion to the bulk and weight of the stone. This is a very curious phenomenon, the explanation of which is not furnished by the fundamental laws of acoustics, and which surely merits being studied by physicists.

As long ago as 1873, I spoke of musical stones as a curiosity worthy of attracting attention. I then promised to return to this interesting subject, but the years passed by, and the singing stones were forgotton. Upon recently visiting the new electric lighting of the Grévin Museum, however, they were casually brought to mind again. After examining this interesting installation, I was walking through the great hall of the museum, looking at the wax figures mounted therein, when I heard some delightful music that attracted my attention. Approaching the spot where these harmonious and pure sounds were being produced, I saw a musician, who, holding two flints, was playing upon a stone piano with wonderful agility, by striking other flints of all shapes suspended by two wires at a few fractions of an inch above a sounding-board. I at once made the acquaintance of the player, who was Mr. H. Baudré, a distinguished musician and a zealous collector of musical stones.

"How did you procure these flints that render so delightful sounds, and from which you get so remarkable music?" said I.

"Ah, sir, it required much time and many trips to collect the twenty-six stones which you see before you, and which form the two chromatic octaves. It took me more than thirty years (from 1852 to 1883), to search for them in the chalk-beds of Haute-Marne, Périgord, Eure, and the Paris basin."

"Are such flints found in all chalk formations?" "I believe not; the innumerable quantities of English flint have yielded me nothing acceptable." "Are there any works that treat of this interesting subject of singing stones?" "I do not know; but I have letters from numerous scientists, who have been pleased to congratulate me, or to give me their opinion."

"Would you communicate a few of them to me? I should like to publish them in *La Nature*." "Very willingly, sir; I will send you my file to-morrow."

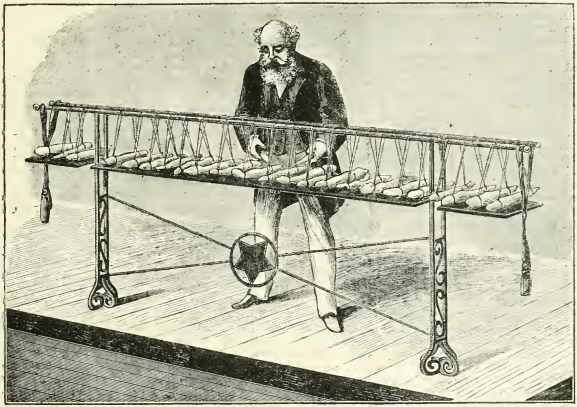
The following are a few of the notes that appear to me to give some new information in regard to singing stones.

M. Cartailhac, director of the Toulouse Museum, reports that three musical flints were once noticed by a missionary in the village of Chaffa, in the centre of the plain of Thumazana, Abyssinia. These stones were hung by threads from a horizontal wooden rod, and were used for calling the faithful to prayers or to battle. They were struck with another flint, and their sounds, which were very intense, were heard from some distance.

In an interesting letter to M. Baudré from Mr. J.

Ellis, member of the Royal Society of London, this learned scientist treats of the sonorousness of singing stones. "We know not up to the present," says he, "whether the sonorousness is affected by the form, bulk, chemical mass, or molecular constitution. It is very probable that these stones have internal structures that differ from each other—the sound of the stones being different when they are struck in two neighbouring places. I should not be surprised if there were a sort of obliqueness in the structure, which would explain the impossibility of preserving the sound when a singing stone is cut or broken.

"There is here an interruption of the sonorous waves that are passing through the body. The great difference in the sounds that two bodies of nearly equal bulk are capable of producing is probably due to a difference in the arrangement of the molecules, which govern the mode of vibrating. I am sorry that I am unable to say more on this subject."



M. Baudré calls his singing stones "prehistoric music." It is not impossible, in fact, that analogous keys were used by our ancestors of the Stone Age. This was Abbot Moigno's opinion.

"Who knows," says the old editor of *Cosmos*, "whether, in eagerly excavating in search of relics of the Stone Age, we shall not find a series of attuned flints? Why may not the flint, which was the first arm, the first tool, of pre-historic man, have also been his first musical instrument?"

M. Baudré thinks that the reason no musical instruments have been found in prehistoric strata is that searchers have not occupied themselves with native flints, but only carved ones.

The following are some of the peculiarities of these attuned stones: The stone that emits the greatest tone weighs $4\frac{1}{2}$ lb., while the one that gives the half tone of this weighs 9. This large flint is immediately followed by one of one ounce, that finds its similar in weight only at the end of the series, although the difference in sound is considerable. A three ounce stone gives exactly the same note as another that weighs but 6,000 grains. It will be seen that we have surprising anomalies here to puzzle physicists.—*G. Tissandier, in La Nature.*

THOUGHT AND LANGUAGE.

BY ADA S. BALLIN.

XVI.

IN my last article I alluded to the fact that those characteristics acquired latest in the race and in the individual are the first to be lost in cases of degeneration. Thus the child walks on all-fours before he acquires the power of walking erect; and, occasionally, idiots are met with who can never be taught to walk otherwise than as quadrupeds do. Sometimes the patient seems to belong to a lower stage of evolution to that into which he is born, and animal instincts and propensities are linked with incapacity for the use of language. Although I have, unfortunately, not been able to obtain further particulars, I take it that the following cases belong to this class.

"F. F. G.," in the *Lancet*, Feb. 21, 1885, mentions a child, aged nine, who is one of four or five, none of whom can speak intelligibly—saying only a few simple words, and those only half articulated. This child has had no illness, but is very perverse, and developes frequently a strong tendency to mischief and destruction: tearing clothing, breaking windows and furniture, &c. Such fits last about a day; in the intervals she is very

intractible and disobedient. He regards them as evidences of epileptiform seizures, with tendency to insanity. The parents are related (cousins, I believe); no other family history. It seems to me that this is an instance of pure mental atavism—reversion to an ancestral type somewhat resembling that of the monkey, brought about by congenital nervous defect combined with disease.

In cases of brain-disease where the intelligent use of language is lost or impaired, when words are used in the presence of the patient, they are frequently imitated and repeated by him in a meaningless way. Prof. Behier* had a patient who was born in Italy and had lived in Spain and France; she thus mastered three languages, but lost the use of Italian and Spanish, and only retained a most limited power over French, in which she could *only repeat like an echo*, and without attaching any meaning to them, the words pronounced in her hearing. Bateman, the celebrated writer on aphasia, saw in the Salpêtrière a woman with whom the tendency to imitate was still stronger; she reproduced foreign words formerly unknown to her, although not as intelligibly as her native French words. Her articulation was distinct. When a patient in an adjoining bed coughed, she instantly imitated it. She repeated everything that was said to her, whether in an interrogative form or not, and imitated every act that was done before her with extraordinary exactness. A somewhat similar case occurred in Trousseau's clinique in the person of a man named Marcou, whose stock of words was limited to the emotional expressions, "My faith!" (Ma foi!) and "Cré nom d'un Cœur!" When asked what his name and his occupation were, he replied, "My faith!" On Trousseau's insisting, he only shook his head with an impatient gesture, exclaiming "Cré nom d'un Cœur." As Trousseau wished to discover how many words he could use, he asked, "Are you from the Haute-Loire?" "Haute-Loire!" echoed the patient. "Your profession?" "Haute-Loire." "But your name is Marcou?" "Yes." "You are sure it is Marcou?" "Yes." "What department do you come from?" "Marcou." "No; that's your name." With an impatient gesture he exclaimed again, "Cré nom d'un Cœur."

As we descend in the scale of human intellect we find that the tendency to imitate has increased power. We all experience this tendency ourselves when not intellectually active, as when a cough, a sneeze, or a yawn goes all round a church, lecture-hall, or concert-room;† but in nervous disease and among peoples of a low class of intellect, such as savages or uncultivated peasants, it is very much more marked. Among the lower classes of various nations this mental phase is seen in exaggerated form. The "Jumpers" of America will obey any order, however absurd, and repeat words in languages of which they are entirely ignorant. Among the Russians it assumes the proportions of a nervous disease, and is called "Miryachit." The patient has no power to resist imitating actions which he sees or hears performed by others, such as clapping the hands, shouting, or even stumbling and falling. In his "Journey to the Amur," Dr. Meak says that it is not unusual for the Maniagri to suffer from a malady of this kind, which is met with chiefly among the wild people of Siberia, but also among the Russians settled there. It is also common among the Yakutes and Argurian Cossacks; those suffering from it under the influence of fear or consternation unconsciously imitate whatever passes before them. I can only look upon this so-called disease as a symptom or evidence of nervous degeneration, and the statement that the imitation is more frequent when the patient is terrified, and, as we may call it, "nervous," justifies this opinion. In the same way in slight cases of chorea we find the involuntary movements which characterise the disease increased by nervousness, as when the patient is being questioned about the disease or asked to perform certain voluntary movements of which she fears she is incapable.

Mr. Jagor observes in his "Travels in the Philipines,"* that this disease of nervous mimicry is well-known in these islands under the name of *Mali-Mali*, and in Java under the name of *Lakit-latar*, and he tells how he and his companions availed themselves "of the diseased condition of a poor old woman who met us in the highway, to practise some rough jokes upon her. The old woman imitated every motion as if impelled by an irresistible impulse, and expressed at the same time the most extreme indignation against those who abused her infirmity." Dr. Neale, writing on the same subject, says that whatever attitude is assumed these individuals must adopt the same. If they are carrying anything and see another person drop an article, down goes their burden, however precious and previously carefully carried, even if it is a valuable piece of crockery or a well-loved infant. He continues, "On one occasion I wished to extract a tooth from a young woman the subject of 'lata,' but no coaxing could avail to induce her to open her mouth. At last I took a chair, and she did likewise, I moved it gradually towards her in front, and she as gradually approached me. I then yawned very widely; she followed suit. I then shut my eyes very tight, which action she strictly imitated. Quickly jumping up I clapped on the forceps, and had the tooth out before she had time to resist further." Some years after this girl came to England as a servant, and one day, while waiting at table, her mistress wished to exhibit her peculiarity to some friends, and seizing a large French plum pretended to swallow it. "The woman instantly made a dash at the dish, thrust a plum in her mouth, and, after much choking and semi-asphyxia, succeeded in swallowing it; but the situation was such that her mistress did not repeat the experiment."

It is well known that healthy children will often acquire chorea solely from seeing others afflicted with the disease; but one of the most forcible illustrations I can imagine of the power of imitation is that afforded by a report of the Massachusetts Asylum for the Blind, in which Dr. Howe observes that a blind child during the vacation got St. Vitus' dance, and that when the school reassembled, the disease spread so rapidly among the children that, in order to arrest it, they had to be separated and sent home again. The choreic movements must have been imitated wholly through touch.

Physiological action increased beyond the normal intensity becomes pathological action, and thus we see that imitation, which, as we descend in the scale of human intelligence, becomes more and more a physiological unit of the constitution, may pass with great facility into a well-marked disease.

* "Gaz. de Hôpitaux," May 16, 1867.

† "Laughter is catching," as we all know. As a rule, if an actor on the stage laughs, the whole audience involuntarily copies him, whether the joke is generally understood or not. A short time back I went to German Reed's, and saw "Hobbies," a piece in which one of the actors becomes possessed of a "laughing gas" machine, which makes him go into ecstasies of laughter; the audience was convulsed, and although I was anxious to watch this phenomenon in the interests of psychology, it was perfectly impossible for me to withstand the infection, as it may well be called.

* p. 159.

The lower we descend in the scale of human intelligence the nearer do we approach the highest types of animal mind, and accordingly we find that the faculty of imitation is largely developed among the more intelligent animals, and is at its highest in monkeys. In the human infant it begins very early. Preyer says that the first imitative movement begins as early as the fifteenth week, when the child copies the action of protruding the lips if it is performed before it. Towards the end of the first year imitative movements become more numerous and more quickly learnt. At twelve months Preyer saw his own child repeating in its dreams imitative movements which had strongly impressed it when awake; for example, blowing with the mouth. Later still, complicated imitative movements are repeated for amusement, as seems to be the case with monkeys. "With growing intelligence (as Romanes says) this faculty subsequently declines, and in after life may be said to stand in an inverse relation to originality or the higher powers of the mind. Therefore among idiots below a certain grade (though, of course, not too low), it is usually very strong, and retains its supremacy through life, while even among idiots of a higher kind, or the 'feeble-minded,'* a tendency to undue imitation is a very constant peculiarity. The same thing is conspicuously observable in the case of many savages, so that in view of all these facts we must conclude that the faculty of imitation is one very characteristic of a certain area of mental evolution." †

OUR HOUSEHOLD INSECTS.

By E. A. BUTLER.

COLEOPTERA (*continued*).

We have only one other group from which to select examples of British household Coleoptera. These are the most highly developed of all, the Geodephaga (or predaceous ground beetles, as the name signifies), which in classifications are placed at the head of the whole order. Two species of this important group are found in cellars and dark outhouses. They closely resemble one another in shape, but, nevertheless, may easily be distinguished both by size and colour. The larger, *Sphodrus leucophthalmus* (Fig. 1), which is also a bakehouse insect, is black, and the smaller, *Pristonychus subcyaneus* is, as its trivial name implies, of a steel blue colour. Both are exceedingly active, as well befits creatures which carry on a perpetual warfare against their smaller and weaker brethren, and subsist by rapine; indeed, the whole section Geodephaga are renowned for the extraordinary agility of their movements, in which characteristic they surpass all other Coleoptera, and in conformity with these habits, their legs are long and slender. The name *Sphodrus* is Greek for the "active, violent, or vehement one," and so far as mere meaning is concerned, would be equally applicable to almost all the Geodephaga.

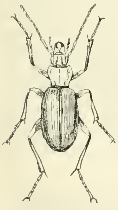


Fig. 1.—Sphodrus leucophthalmus (natural size).

Sphodrus is a fine insect, fully an inch long; but *Pristonychus* attains little more than half this length. They are so similar in shape that a figure of one will be quite sufficient to enable both to be recognised. The most elegant part about them is the thorax, which is of the form called by entomologists "heart-shaped"—that is, the outline of the margins consists of a double curve on each side, the front half being convex and the hinder concave. This has the effect of forming something like a waist, and of imparting an air of neatness and refinement, so to speak; and, therefore, even *Sphodrus*, though so large, can certainly not be considered either coarse or clumsy.

A formidable pair of jaws, with which the insects can give an unpleasant nip, if incautiously seized, project in front of the head like a pair of shears. The pair of small jointed appendages, like two minute antennæ, by the side of these, are the maxillary palpi, or feelers attached to the maxillæ, or secondary jaws, which underlie the mandibles or true biting-jaws. The insects lurk under stones and in dark corners, and if suddenly disturbed in their hiding-places, make the most frantic efforts to recover their shelter. They can always find plenty of food, in the shape of the other cellar Celeoptera, to which we have already referred, and many other kinds of insects that frequent such situations.

Besides the more legitimate coleopterous inhabitants of our houses, which we have described in the preceding articles, there are, of course, plenty of stray visitors that may at any time turn up. On a fine summer day, windows into which the sun is shining brightly often have a considerable insect population, amongst which many beetles may be found, especially such as ladybirds and tiny rove-beetles. Sometimes great rarities may be met with in this way. Thus the Rev. W. W. Fowler records having taken, off a lodging-house window at Hunstanton, two minute beetles which had scarcely ever been met with in Britain before, beetles which were not household species at all, but simply casual visitors which had flown in and been unable to find their way out again. The corridors of the Crystal Palace, similarly, often yield hosts of tiny beetles, and there is one species that is specially noted as occurring there.

Our food, too, sometimes introduces us to more insects than we care for. House-flies, drowned in milk or soup, or fossilised in bread, and caterpillars boiled with peas or cabbage, will, of course, at once occur to one's mind; and, indeed, considering the inquisitive nature of some of our household pests, it is a marvel that we do not get more of them served up to table than we do. Foreign beetles sometimes occur in brown sugar, easily hidden amongst the crystals as long as the sugar is in the solid form, but brought into undesirable prominence when it has been dissolved in our coffee; the only specimen my cabinet boasts of a certain species that is now reckoned as British, though, no doubt, originally imported, was thus fished out of a cup of tea. And it is not merely *small* insects that appear in this way. I once met with a fine large South American weevil in a gooseberry tart; it was a handsome species, of a purplish-brown colour, with some clear yellowish-white circular spots, and was about half-an-inch long. It was in excellent condition, and not in the slightest degree damaged by the cooking it had undergone, but able to be set up as a perfectly respectable cabinet specimen. I have known, too, of an instance in which the shell of a pond-snail came to table in a loaf, apparently having reached so strange a position through the medium of the water used in mixing the dough.

Beetles, too, may be found on our doorsteps, or climbing the walls of our houses. I once met with two specimens, the only ones I possess, of a rare beetle, one, in fact,

* See the case of the deaf and dumb idiot negro boy cited in Article XI. of this series, KNOWLEDGE, No. 190.

† "Mental Evolution in Animals, 1883," p. 225.

which has only of late years been recognised as British, climbing up a pillar just outside the front door of a house. Many may also be found in thatch: if an old thatched roof, which has become black with age, be beaten with a stout stick, and the dust and rubbish that come out be caught in a bag, and afterwards carefully examined by shaking it over a piece of white paper, the beetles it contains will easily be seen; they are mostly exceedingly small, but some are very interesting forms. In birds' nests built in the gutters or under the eaves, and in pigeon-cotes and fowl-houses, many species also habitually live. If a quantity of the filthy refuse that accumulates on the floor of a fowl-house be shaken over paper, hundreds of beetles will come tumbling out, some of them even sufficiently valuable to make amends for the unpleasantness of the method of obtaining them.

In country-houses, if an old log be put on the fire, any insects it may contain, speedily finding their quarters becoming too hot for them, make their escape, and as often as not find their way to the window, where, of course, they are readily observed and may be easily captured.

Here we may conclude the consideration of the first order of insects, the Coleoptera; in the next paper we shall proceed to notice the second order, the Hymenoptera.

(*To be continued.*)

Gossip.

By Richard A. Proctor.

After the last number in September Knowledge will be published as a monthly magazine, price sixpence.

Like other monthly magazines, Knowledge in future will not be open to correspondence properly so called. Communications addressed to us by readers, in regard to subjects of interest with which they are conversant, will of course be welcome as they have always been. But argumentative letters would manifestly be out of place in a monthly magazine; indeed I imagine that argumentative persons would not be content with so slow a method of conducting their discussions as a monthly magazine would afford.

I am obliged to admit that the introduction of the correspondence element, and especially of the replies to correspondents, was a mistake from the beginning. We have had communications of great value from several correspondents, and among the questions asked have been many which it has afforded myself and others pleasure to deal with. But the trouble has arisen which always, as it seems, must arise in such cases,—the difficulty of excluding correspondence of the argumentative sort, suggested not so much by any desire to get at the truth as by the wish to air theories which have had their origin in ignorance or misapprehension. The trouble is not so much that correspondence of this sort occupies space which can be ill spared, as that it tends to drive away, gradually but surely, such correspondents as really have interesting matter to communicate. I have to thank several able writers for the kindness with which they have resisted the natural tendency to withdraw from correspondence leading to controversy, and sometimes to controversy of the idlest possible kind. But the influence of the sense of discomfort thus occasioned must tell in the long run. I know this from my own experience, remembering how I was compelled to withdraw from the correspondence columns of the *English Mechanic* because of the association into which I found myself brought with paradoxists, flat-earth men, weather prophets, circle-squarers, and others of like sort. Controversy equalises in the eyes of outsiders the ignorant and the well-informed, and the ignorant know this. Science suffers by such controversy, because well-established facts are made to appear as if they were subjects for discussion, where in reality they have simply been misunderstood. In the columns of Knowledge, hereafter, scientific, literary, and artistic matters will be dealt with by those who know, not discussed between those who know and those who do not know.

With regard to questions, I simply cannot longer afford time to answer them in Knowledge. I have had great pleasure in replying to legitimate questions, and so I am sure has my friend the acting Editor. But questions have been poured in which are not legitimate. We have been asked to solve problems given in examinations,—as if we were in the private tutor business. We have been asked to explain matters which should be studied in text-books. Men so ill-informed or so limited in brain-power that they cannot understand simple explanations, have started out as original discoverers, propounders of new theories of the universe, and so forth, abusing us for not at once accepting their perplexities as new and brilliant lights. Then among the letters sent to us (in company, be it always admitted, with others that are most pleasing) are some giving vent to the hee-haws of vulgar buffoonery. "Jolly Dogs" (wanting knowledge, but what they want with Knowledge we do not find) send letters smelling of stale tobacco and suggestive of beery influences, beginning (for example) "You'll be the death of me, I know you will," and going on, perhaps, to ask who on earth believes the untruths (monosyllabic) which geologists, chemists, or astronomers are always telling,—making special reference, it may be, to some of the most elementary truths in the sciences jeered at.

All this would not in the least matter if the work of answering correspondents were in itself light. But in reality the work is not light; it has taken time which could very ill be spared: it has in fact involved a costly expenditure of both time and labour, for which I have had no return. I withdraw from the work, after giving it four years' fair trial, with the expression of my thanks to the many kindly correspondents with whom I have been brought into contact in this part of my work on Knowledge, of my regret that our pleasant fellowship should have been in some degree impaired by the irruption of persons ill-informed or ill-mannered, and of my sorrow that apart from this I could not have continued the work. I have much work to do, or at least which I wish and hope to do; my health and strength are not what they have been; and I must devote what time and capacity for work may remain to me, to the more serious business I have in hand.

I remark however, that as the Gossip columns will not only remain open but be extended, questions relating to matters of general interest may still be dealt with in a form useful to the general reader. I *promise* nothing in that direction, partly because I do not want to invite questions, and partly because I cannot tell what time I may find available for such matters.

In the nature of things Knowledge as a monthly magazine must be an experiment. I shall spare no pains to make it a success. I hope friendly readers will co-operate, as they can very readily and effectively do, by announcing to others the new departure. The form in which Knowledge has hitherto appeared in regard to size of page will be retained; but as there will now no longer be that necessity for rapid work which the weekly number had involved, Knowledge will present in many respects an improved appearance. Original articles will occupy a larger relative proportion of our space, which will of course be also absolutely larger. The complaint which some have made of the scrappy form in which our leading subjects appear will no longer be justified. As to the quantity of matter, original and select, in each number, comparison can be confidently invited with any monthly or weekly serial, not backed by novels or short stories, or padded with mere business communications or the long-winded drivel of paradoxists and their kind.

I hope to receive for "Knowledge, a Monthly Illustrated Magazine of Science, Literature, and Art," such support as will amply justify its continuance in the course entered upon. I will not say less; but there is so much other work inviting me that (remembering duties nearer to me than those I owe to science) I cannot at present say more.

We are going to change our course somewhat freely in another respect. At the outset of our career, we expressed a determination not to deal with the influence of science on religion, though satisfied that that influence had been purifying and wholesome. This was regarded by many as a promise. In reality it was a precaution. We wished to escape the flood of controversy, which we knew would pour in upon us if that subject were opened. That we did not escape, a glance at the "Replies to Correspondents" will serve to show; but we kept our correspondence columns tolerably clear of the *odium theologicum*,—which was our principal object. But now our position is different. We can present the views of science in regard to religion without introducing controversy. We can answer the questions which are repeatedly being asked as to what science can do to replace the religious feelings which many seem to think, mistakenly enough, that they must abandon if they would tread the scientific pathway.

You give us, say many, the Everlasting No, in which is neither hope nor solace, neither help in the work of life nor promise of better things hereafter. Is science without religion and without hope? Must the votary of science be without faith, without worship, without a law of duty?

We shall endeavour to show that the teachings of science involve no such gloomy and hopeless picture. Science answers with an Everlasting Yea, the questions of those who desire to possess faith, to feel reverence, and to recognise the sense of duty and right.

The great philosopher of our age is not anxious to be followed by a train of disciples; he would preach no new religion. But he knows, what others have felt, that the purifying of old religions from the dross of ages is no destructive process. Through the infinite azure depths of the cleared sky the real glory of the universe is beginning to be seen. Purified—even it may be to perfect transparency,—religion will remain religion still. It will have its temples, but temples not made with hands; its worship, but a worship cleansed from all that is unworthy; its code of morals, but a code based on reason and on justice. One characteristic alone, which has been associated with religion, the religion taught by pure science will not possess. Its very essence will be freedom from all intolerance. Because it recognises in all true forms of religion a yearning after good, a desire to feel the presence and power of something outside of us that makes for right,—science can be intolerant only of intolerance. The religion of science is indeed in harmony with all true-aiming religions, discordant only with what is self-discordant,—the jarring voice of cruelty and hatred.

We propose to begin, in our first monthly number, a series of papers in which the positive aspect of the teaching of science in regard to religion will be considered. We had intended to bring out this series of papers as by Thomas Foster, our *alter ego;* but as it is now an open secret that Thomas Foster and R. A. Proctor are one, the better plan will be to put over the articles the proper name of their writer. The use of a second name has served its purpose, in securing for articles outside science, attention which the old rule "*Ne sutor ultra crepidam*" would have turned from them. Mr. Foster's articles on "Happiness" for example were published widely in America (and handsomely paid for, let me remark in passing) by the editor of the *Popular Science Monthly.* But there were inconveniences in the plan. For instance, Mr. Foster was invited by one of the most eminent Spencerians in America, to meet other admirers of Mr. Herbert Spencer, including Mr. Proctor, at a public gathering,—an invitation which he could not readily decline yet could not possibly accept without duplicity.

Hereafter, therefore, Mr. Thomas Foster disappears from these pages. (It should have been Forster,—from an old family cognomen Forster Thomas, by which the eldest son in my family has been called for many generations, but I had forgotten how the name was spelled, —not so remarkable a forgetfulness as it might be supposed, seeing that the last owner of the name died twenty years before I was born.)

"A Father" writes indignantly thus respecting lawn-tennis as played by his daughters:—"I have noticed that after a game of lawn-tennis my girls appear to be almost exhausted, they perspire profusely, and are susceptible to draught. Their sleep is disturbed because of their excessive weariness, and they have several times been lamed and used-up. I have finally forbidden them to play lawn-tennis. I am not going to have my womenkind laid up with sprained ankles and twisted wrists, strained tendons and colds in the head."

Quite right, papa. The best tennis-players of the masculine persuasion will not be angry with you for keeping your girls away. It is obvious from your account, read between the lines, that your "womenkind" have tried to play in corsets and high-heeled boots, getting far more exhausted through their ill-suited habiliments than through the mere exercise. (Though girls *will* overdo such things, just as they overdrive willing horses, and dance too often and too long.) In rational dress lawn-tennis would not be half the work they find it, and would assuredly give ten times as much

pleasure to themselves, to their playfellows, and to lookers-on.

But now hear what the other side says about it. A "London Tradesman" who is himself a player of no mean skill, after saying that he has sold more tennis-balls already in 1885 than he did during the whole of 1884, and that lawn-tennis is the game of the future, adds that women had better leave the game to the men. "Women don't play well," he says. "They haven't got the requisite amount of muscle, and they won't spare enough time to acquire it. Women dress themselves in a way that makes a cripple of the best tennis-player in Christendom. They allow no freedom for their bodies. Until they do without corsets and skirts they must not expect to play tennis well. The only good tennis-players are men, and it is seldom you find an expert at the game who will consent to play with a woman. It spoils his style; it makes him lazy, and when a tennis-player loses style and becomes lazy; he had better throw away his racket."

The bitterest part of this is that about experts not playing tennis with women. Most women fancy they play on the average quite as well as men. But it is only because the good players keep away from them. And now probably even the bad players will cease to play with the girls, because it is becoming a recognised thing that only duffers do that, and no young fellow likes to be thought a duffer. Old fellows even do not care to be thought duffers. Very tender and sweet young curates, with an eye to slippers and braces, may still be found trying to play lawn-tennis with the young ladies of their flocks; sheep gambolling with lambs, so to speak. But will the girls be content with easy victories over these tender ones?

There is hope only, it would seem, in the divided skirt, rationally adopted so as to attract no notice,—nay, my occasional observation of lawn-tennis as played by ladies has suggested that under certain conditions which occasionally arise, the rational dress is calculated to be more seemly than the heavy skirts which render corsets necessary. But I am not an expert in the matter of ladies' dresses, nor have I seen the "patterns of rational dress" which are weekly advertised on page ii. of the Knowledge advertising sheet. I only know how the dress looks when complete, and how much it contributes to grace and freedom of motion.

In the following letter which appeared in the *Times* for August 26, I have called attention to a point of great importance to all who have occasion to communicate with friends across the Atlantic—from either side:—

Risks in Transatlantic Telegraphy.—To the Editor of the *Times*.—Sir,—Out of fifteen transatlantic telegrams which I have had occasion to send, or to have sent to me, during the last six years, three have miscarried. This is too large a proportion of failures, and the public ought to know how much or how little they can trust transatlantic telegraphy as at present conducted. Here are, in brief, the particulars of the three failures and of the compensation—save the mark!—made by the persons responsible. In the summer of 1879 I depatched from the office near Burlington House a telegram to my lecture agent in New York on important business, telling him to wire reply. No reply coming, I wired again, and was told no message had been received. For compensation I received expressions of regret and the price of the original message. Last June I wired from St. Joseph, Missouri, to my lecture agent here, in reply to a telegram of his on important business. Late in July I received a letter from him, saying that the telegram referred to in my letters had not been received. I found it had got as far as London, but had not been forwarded. For compensation I received very courteous expressions of regret from the head post-office, with suggestion that I should write to St. Joseph for return of the price paid for the telegram. On August 6, at 11.30 a.m., I wired from Liverpool (office under North-Western Hotel) a message to St. Joseph, Missouri, in one word; but that word announced my safe arrival, and gave instructions on a business matter of importance to my wife. I have to-day received a letter from her, dated August 8 (not a mistake, for she mentions that guns were firing, &c., because it was the day of General Grant's funeral), from which I learn that my telegram, sent off at 5.30 a.m., St. Joseph time, on August 6, had not been received at mid-day on August 8. I do not yet know what compensation, if any, will be offered. Possibly the telegram may have been since delivered—on August 16, for example, in which case no compensation need be expected.—Faithfully yours, Richard A. Proctor, Eastbourne, Aug. 22.

I would advise all transatlantic travellers, who do not wish to cause their friends anxiety, to refrain from telegraphing their arrival. When their friends expect a telegram, as they would be sure to do if they understood it was the traveller's intention to telegraph, its non-arrival would naturally be understood to show that some serious mishap had taken place. Business communications *known to be such* (from their form, for example) may possibly be exposed to less risk of failure. It is to be hoped so. The two business communications referred to above were not so worded that their business character as such could be recognised. I shall be glad to receive and publish evidence bearing on the trustworthiness of transatlantic telegraphy.

Professor Stokes, in his lectures on light, inclines to the belief that Sir F. Herschel's suggestion may be correct, according to which the development of a comet's tail is due to electric repulsion; and Professor Stokes suggests on his own part that the repulsion may be due to an electric charge on the sun, resulting from the process of condensation in the mist particles of the comet's head. I wonder whether any direct evidence showing that either suggestion is sound will ever be obtained. Professor Tait, of Edinburgh, commenting on Professor Stokes's ideas, expresses his still lively love for the "swarm of cosmical brickbats" theory, which he mistakenly imagines to have been suggested by astronomers in explanation of comets' *tails*. In reality, no astronomer ever supposed the cosmical brickbats (that is only Professor Tait's funny way of saying meteors) had anything to do with comets' tails, near which they have never been seen.

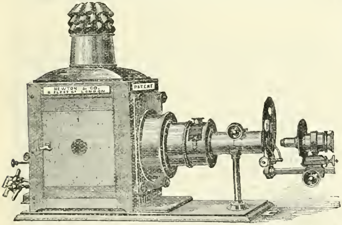
Mr. J. Joly, of the Engineering School, Trinity College, Dublin, suggests as a novelty (I quote from my "Popular Science Column" in the *Newcastle Weekly Chronicle*) the method for avoiding icebergs, which I suggested in 1879, just after the *Arizona* had run into an iceberg at the rate of fifteen knots an hour. "I would like to ask," he says, "whether a thermal radiation method might not serve to show the presence of a large mass of ice in the neighbourhood of a ship." The use of such an instrument as the bolometer of Professor Langley, "or even of the thermopile, in conjunction with a large reflector and an alarm circuit closed by galvanometer deflection, might be worth trial by any one possessing the opportunity." In every detail, the opinion of Mr. J. Joly supports the view that I expressed in the columns of the *Newcastle Chronicle* six years ago. Collisions with icebergs occur seldom, but when they do occur they are apt to be so terrible in their effects, that something might be done, in the case at any rate of our ocean steamships, to warn the sailor of the proximity of the great ice masses which float silently athwart the oceanic roadways.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

LANTERN MICROSCOPE.

[Patent No. 14,951. 1884.]—This instrument is constructed from the designs, worked out by protracted experiment, of Mr. Lewis Wright, and with it screen demonstrations can be given by the oxy-hydrogen lime-light, of a character hitherto quite unattainable. Ample light is obtained for the magnification of ordinarily transparent subjects to 1,250 diameters, which will display in a clear and beautiful manner all the parts of insects, the minute details of anatomical sections, vegetable tissue, &c., quite as sharply, and almost as brilliantly, as a magic lantern slide; the proboscis of a blow-fly is easily displayed with the various powers from 8 to 14 ft. long. Where transparency of ground is combined with opacity of detail, as in the cornea of a fly's eye, a magnification of 2,500 diameters is attainable. Geological sections are admirably shown either by ordinary or polarised light. The microscope can be fitted to any good optical lantern. In the special lantern constructed for use with the instrument, a triple 5 in. primary condenser is used, which takes up the large angle of 95° of light from the radiant. Almost equal results can, however, be obtained with the 4 in. condensers usually supplied in optical lanterns, by the addition of a third lens, the triple 5 in. condenser being reckoned to give 15 per cent. more illumination. The slides need no special preparation.



The most delicate slides are absolutely and perfectly protected from heat by an inch of alum solution and a layer of Canada balsam, which is not the case with any other lantern microscope. After passing the parallelising lens, the rays are coned down by sub-stage condensers to illuminate an object of the required size. These sub-stage condensers are either single, double, or triple combinations of lenses, according to the power of the objective which is to be used with them, and are inserted in a rack tube to give the necessary adjustment of distance from the slide. The series of powers, part of which have had their optical arrangements worked out on the screen expressly for this instrument by Messrs. Newton & Co., and the remainder of which have been selected by Mr. Wright from scores of lenses by exhaustive trials, are of the highest class, giving a flat image with full illumination and sharp definition to the edge of the field.

All the manipulations are absolutely simple and easy in the dark. The objectives are fitted to the R.M.S. Standard screw, and the body of the instrument is fitted to receive any achromatic condenser or other apparatus fitted to the standard $1\frac{1}{2}$ in. sub-stage gauge. The apparatus may certainly be classed among the best-constructed and most ingeniously-conceived inventions of the day, and will doubtless be very extensively employed. It has already received eulogiums from many competent judges.

Miscellanea.

AMERICAN LIGHTHOUSES.—The United States Lighthouse Board has approved plans for a compressed gas-lighted beacon at Romer's Shoals, New York, for which 25,000 dols. were appropriated by Congress last session. The beacon will be a skeleton iron structure, 41 feet above low water.

REMARKABLE BICYCLE RIDE.—Mr. E. Oxborrow, of the Æolus B.C., has just accomplished an extraordinary day's journey on a "Facile" safety bicycle. Starting from Hitchin at midnight on Aug. 25, he rode, *viâ* Peterborough, Long Sutton, Lynn, and Swaffham, to Norwich and back as far as Biggleswade, which he reached at 11.58 p.m., on the 26th, having thus covered a distance of 263 miles in the twenty-four hours. This is within three and a-half miles of the present record, which was made last year by Mr. J. H. Adams, who also rode a "Facile."

A REMARKABLE CASE.—Dr. Strumpell, of Leipzig, had under his care, a few years ago, a young man who had suffered from a disease of the brain which had destroyed sensibility to touch over the whole body, and also the functions of one eye and of one ear. When this youth kept open his remaining eye and ear, he remained perfectly wide awake, conscious, and intelligent. But when his still efficient eye and ear were carefully closed, he immediately became unconscious—in fact, he could only remain awake by keeping that eye and ear open. This case is suggestive. It appears clear that the functions of the mind are dependent absolutely upon the reception of energy from the sensory perceptive areas.—*Newcastle Weekly Chronicle.*

AMERICAN ANTHRACITE.—The second geological survey of Pennsylvania has just published advance copies of its report on the anthracite coal region, giving some interesting information as to the production and shipments of 1884. During that year there were 377 producing collieries. The total shipments in 1884 were 30,718,293 tons, and the total production 32,641,499 tons, or about 1,300,000 tons less than in 1883. More than half the total product came from the Lackawanna and Wyoming coalfields, while the Pottsville coalfield, which, up to 1857, produced more than half the anthracite coal sent to market, yielded in 1884 less than 10 per cent. of the whole.

SCIENCE LECTURES IN LONDON.—The series of weekly lectures on popular science will shortly be recommenced at the Royal Victoria Hall (late the Victoria Theatre—more usually styled the "Vic") in the Waterloo-bridge-road. These lectures are given on Tuesday evenings, and while the charges for admission are little more than nominal, the committee have been able to secure the kind co-operation in their good work of the leading men of science of the day. Wisely appealing to as many of the senses as possible, nearly all the lectures are well illustrated by the aid of a fine oxy-hydrogen lantern. The lecture on Sept. 29 will be given by our contributor, Mr. W. Jerome Harrison, F.G.S., on "Stone Tools and the Men who used them," and will be illustrated by a fine series of slides.

SUICIDE IN NATURE.—Early in December, 1879, an apparent epidemic of suicide attacked the herrings and sprats in Deal Roads, and they rushed ashore in such myriads at Walmer that the fishermen got tired of carting them off, and they were left on the beach for all who cared to help themselves. Nature seems now and then to put bounds to over-population, but if this be the case, no herring famines need be feared, for economical Nature would never have played into the hands of the fishermen who are always at war with her. Such wholesale suicides occur among other forms of animal life. In Africa regiments of ants have been seen deliberately marching into streams, where they were immediately devoured by fish. Rats have migrated in myriads, stopping nowhere neither day nor night, and have been preyed upon by both large birds and beasts of prey. In the Seychelles some years ago several hundred turtles conspired to die together on the island in front of the harbour, and carried out their decision. Were they the victims of hydrophobia, delirium tremens, or some other disease? Even the gay and sprightly butterfly has been known to migrate in immense clouds from the land straight out to sea, without the remotest chance of ever reaching another shore. What could be the reason for such a suicidal act?—*From "The Sea"* for September.

ERRATA.—"Correlation of the two common chords of music, &c." In my letter 1899 on this subject there are a clerical error and a misprint which I shall be glad to be allowed to correct. In the series of ratios of the diatonic scale I have inadvertently written $\frac{4}{5}$ instead of $\frac{3}{4}$. Lower down will be found the word "imitated." It should be "instated."—FRED. J. JACKSON.

TO CORRESPONDENTS

"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

The Editor is not responsible for the opinions of correspondents.

All Remittances, Cheques, and Post-Office Orders should be made payable to MESSRS. WYMAN & SONS.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

FINDING THE WAY AT SEA.

[1900]—Mr. R. A. Proctor, in his interesting article on "Finding the Way at Sea," in KNOWLEDGE No. 199, Aug. 21, 1885, alludes to an important danger in steering a ship—viz., that her compass may seriously deviate on account of the presence of iron in her cargo. In the *St. James's Gazette* of the same date an instance is quoted in which the man at the helm found that he was unable to keep his vessel in her course, and on an investigation being made the irregularity of the compass which caused this difficulty was traced to a passenger's umbrella, which was found to act as a very powerful magnet, and, consequently, diverted the needle.

In both these cases the cause of the variation is accounted for, but I hope Mr. Proctor, or some of his correspondents, will be able to give the *raison d'être* for the following incident, which occurred some years ago, when I went, one of a party of four or five persons, from Algiers to Tunis by sea, on a steamer belonging to a French Company:—One afternoon, about 4 p.m., we were steaming leisurely along the North African coast, being at no time very far from the shore, only keeping out a sufficient distance to avoid the various headlands which jut out into the sea. It was towards the latter half of the month of April; we had a deep blue sky and lovely sunshine over head; the sea was as unruffled as a lake. As we passed a point where some of the higher ranges of the Atlas mountains were visible, the aspect of the heavens in that direction was black and threatening. Presently we heard distant thunder, and saw vivid flashes of lightning over these ranges, but our own surroundings remained as before.

Shortly after, the captain came round to all the passengers in turn, requesting the loan of any compasses which they might possess, for he said his own (and he had several) had all gone wrong. Our party between them produced two or three, and others were also given to the officer by various passengers: but they all exhibited the same unwonted variation, and continued to do so as long as the storm lasted, or until we got out of its influence, when they returned to their normal condition. The captain said afterwards that it was most fortunate that this circumstance had happened by daylight, for had it been dark he must have laid to, as he could not have been sure of his course. COSMOPOLITAN.

THE PHILOSOPHY OF CLOTHING.

[1901]—In his fifteenth article on this subject in KNOWLEDGE (No. 199, August 21, 1885). Mr. Mattieu Williams speaks of the desirability that down should be more generally used than at present, and of its great value in the manufacture of clothing. He suggests the possibility of "carding and weaving the filaments of feather down, such as common duck and goose down, swan's down," &c. This is by no means a lost art, for in Kashmir and in Ladakh, or Western Tibet, which are countries adjoining Central Asia (whence our remote ancestors probably came), a material is woven called pushmina, made from the winter under-coat of various animals, chiefly that of the goat, the bara-singh (a kind of red deer), and the ibex; the dog also has it in those regions. In texture, pushmina resembles the downy portion of the feathers of a bird, its staple is short, perhaps not more than an inch to an inch and a-half in length (rather less than more). The name of this down is pushm, it is made into cloth of the finest kind, and is exquisitely soft. pleasant wear, if it be the genuine article, and no *Liberties* have been taken with it; the real superior article is not easily obtainable in this country. There is one kind, which I only saw once in Ladakh; it is extremely rare, for the down of which it is made (that of the ibex) is only collected by the native sportsmen in very small quantities, and at very great elevations. When the snows begin to melt, and this animal finds its winter coat uncomfortable, it rubs itself against the rocks; the shikaris (hunters) carefully preserve every morsel they find, but it may be years before they can obtain a sufficient quantity of this down to weave even a puggree, or scarf to wind round the hat, turban fashion; the puggree would probably require to be about four or five yards long, and ten inches or so in width. The pushm of the ibex is incomparably finer than that of any other animal. It would be worth inquiry, and is perhaps not impossible, that many animals in the north of Norway and Sweden and in Russia (at all events, those which live within the Arctic circle), acquire this pushm to enable them to withstand the rigours of their winter climate, in which case we need not send to Asia for it, provided we could ensure that such down was not adulterated with other substances. It would then be worth while to try and catch a few Kashmiris and get them to teach us the art of preparing the fibre. COSMOPOLITAN.

GREASY DUCKS.

[1902]—I am not disposed to carry the discussion on this subject any further, as it is simply a question of fact to be settled by observation, not by writing. I simply deny, positively and dogmatically, that any of the feathers of these animals are greasy, and appeal to ducks rather than Huxleys for proof. "G. A." quotes great authorities against me; so much the worse for the authorities, and so much the better for me; he simply proves that, *re* duck's grease, I am a better naturalist than they; that on this mighty subject I have made and proclaimed a great discovery. I have half converted (the lower half) "G. A." himself. August 7th, p. 123, he describes the greasing process as carried "over all parts of the body feathers." August 28th, p. 187, he gives up the greasy breast—*i.e.*, the part immersed in water, and most in need of the alleged waterproofing—and falls back upon the root of the tail as the greased part, this being always out of water, even when the duck tips up, with head immersed, in search of food below.

W. MATTIEU WILLIAMS.

STARLIGHT.

[1903]—I am delighted to find that my idea that the light of a moonless night does not come from the stars is established. (At the same time it is surely rather hard on Mr. Madge to say it exists only in *his* imagination, for it is the universal belief among men—saving those better informed—"a fine *starlight* night.")

I believe that our air is luminous for this reason:—Given two equally cloudy skies, one with high barometer—therefore high clouds, the other with low clouds, the twilight (daylight also, probably, but not so obviously) will be much longer and brighter in the first case than in the second. Now, the clouds cutting off all light, *ab extra*, it appears that the thicker the earthward stratum of air the greater the illumination; hence the air must be luminous.

The keen observer of "Wild Life in a Southern County" writes (xlii.):—"I have myself been often much interested in the remarkable difference of the degree of darkness when there has been no moon. There are nights when, although the sky be clear of visible cloud and the stars are shining, it is, in familiar phrase, "as black as pitch." The sky itself is black between the stars, and they do not seem to give the slightest illumination. On the other hand, there are nights without a moon, when it is (though winter time) quite light. Hedges and trees are plainly visible; the road is light, and anything approaching can be seen at some distance; and this occasionally happens though the sky be partly clouded. So that the character of the night seems not to depend entirely upon the moon or stars. The shepherds on the hills say that now and then there comes an intense blackness at night which frightens the sheep and makes them leap the hurdles."

In all my life there is one particular night which stands out as the blackest—June 4, 1854. I had to walk home through Bedford, and if I had not known it well enough to do it blindfolded I should really have been obliged to grope my way along the streets. This, too, was in the period of "no real night."

It may be said, "If the air is luminous why is not a shut-up room at night as light as when the shutters are left open?" Probably because the volume of luminous matter enclosed is so small.

The popular proverb says, "The darkest hour is just before dawn." If that is true one might conclude that the luminosity of the air is due to the past sunshine, and is hourly decreasing. This might be decided by observation within the Arctic circle, were it not that the moon and the aurora would introduce new elements into the problem. HALLYARDS.

REMARKABLE SKY.

[1904]—August 3, going out between ten and eleven, p.m., I noticed parallel banks of nimbus in the north, and general cloud elsewhere. In a short time these banks spread over the whole sky, and then an arrangement supervened which is unique in my memory. The nimbus became reticulated; one saw cumulus through meshes of jet-black nimbus. The sky looked like the eye of an insect under the microscope; or an immense net thrown over the world. It gave me the impression of being translated to some other planet, with different conditions prevailing. Near the zenith was an intensely-bright white opening, apparently cloud, but I could see stars, and even small ones, through it. I thought at first this cloud was moon-lit, but there were no signs of the moon rising for long after (she had just entered her last quarter). I inclined to think the apparent illumination was only an effect of contrast; the nimbi being so intensely black. They then broke up into irregular, menacing masses; finally, they united into the semblance of a giant balloon—really balloon-shaped, with a depression in one shoulder, and stretching from E. to W. This was really awe-inspiring; not only did it suggest a messenger from another world, but I feared it was going to swamp me completely in a water-spout.

Parturient montes, however, no rain fell that night or the morrow.

I cast about for a cause for this singular reticulation, and think I found it. The upper air was no doubt hot, the weather having been so for long; nimbus for some reason spread over my region; there blew a chill northerly breeze, and this would create a vertical upward current into the hotter upper air. This, meeting the stratum of nimbus, would punch holes in it where it was weakest, hence the network. HALLYARDS.

[More probably, I should imagine, the cause was akin to that which produces reticulate waves—a wind producing a series of longitudinal atmospheric undulations followed by a cross wind producing a similar series at right angles to the former.—R. P.]

EVOLUTION.

[1905]—"It would be disappointing to those who believe in a natural evolution towards perfection to learn from Mr. Colquhoun that the modern Shans are quite as low in the scale of civilization as their ancestors were four thousand years ago. Some of these who have deserted the mountains for the plains of Siam, have shown their capability for advance by adopting the culture of the Siamese; but those who still remain in the hills are neither better nor worse than the Mon, Knei, and others, from whom they sprung."—*Saturday Review*, June 13, 1885.

Is it not well to bring to the front all instances, like the above, which *run counter* to received and fashionable theories?

HALLYARDS.

[But who that knows anything of the doctrine of evolution does or can believe in "a natural evolution towards perfection." That writer in the *Saturday Review* has evidently not been a reader of works on natural selection. The facts recorded do not in the slightest degree run counter to the theory of evolution by natural selection.—R. P.]

[1906]—Having in the last issue of KNOWLEDGE received, both editorially and conductorily, a somewhat forcible rebuff, the sort of lightning stroke of annihilation which I, alas! too fondly, used many a time and oft to admire and applaud with malicious merriment, when falling on the devoted head of another, will you permit me to say a word in vindication of my personal humility and of my respectful veneration of Darwin, and likewise to remove misapprehension by a slight simplification of what I have already said?

If my letter appeared to show an overweening confidence, it was the necessary consequence of having to attack, so to speak, in half-a-dozen words, a structure of such lengthened and masterly labour. If I treated it unduly in a spirit of light-hearted levity, it was owing to a desire to be readable, and from no want of reverence for Darwin, with regard to whom I yield to none in respect.

As to the subject matter of my letter, I wished to bring out, by means of a rather familiar example (which, homely as it is, ought certainly to be met, for it is sufficiently typical), the fact that small variations cannot be at all effective in the struggle for existence. Through the whole of "The Origin of the Species," which contains some twenty-four references to observed variation (chiefly, of course, under domestication), there are only two, and these doubtful, where natural selection, as apart from intelligent breeding, has seemed to perpetuate a slight variation. These are the growth in animals of an instinctive fear of man, and the development of small wing-bones and large leg-bones in the domestic duck. Now, Darwin distinctly states, "Any being if it vary *however slightly* in any manner profitable to itself under the complex and sometimes varying conditions of existence will have a better chance of surviving and will thus be naturally selected." This, as italicised, is what I have tried to deny. Again, "Natural selection can act only by the preservation and accumulation of *infinitesimally small* inherited modifications." "The *slightest* advantage in one being at any age or during any season over those with which it comes into competition, or better adaptation *in however slight a degree* to the surrounding physical conditions will turn the balance."

I quote these in full because it is so astonishing that, in the face of these very definite statements, he should admit a very real difficulty "in understanding the origin of simple parts of which the importance does not seem sufficient to cause the preservation of successively varying individuals." He does not mean such developments as are useless, but those of minor advantage (*e.g.*, giraffe's tail as fly-flapper). Surely this is inconsistent. He goes on to show, not as one would expect from the above quotations, that such unimportant variations, because even infinitesimally advantageous, are still under the control of Natural Selection—that consideration is for the present abandoned—but that such slight variations may perhaps affect an organ of more importance than at first sight appears. Infinitesimal variations are postulated, and then, as soon as we are brought face to face with the fact that they are so small, they are silently abandoned.

There is nothing else in my letter that I think it worth while to contend for, though I should like to reiterate the necessity for caution in accepting theories so agreeable to the time. To me, our Editor and Conductor, in both endeavouring to explain my letter by assuming with such calmness that I had not read a dozen pages of Darwin's works, are only another sad instance of the danger of falling into false hypotheses. P. J. BEVERIDGE.

[I said had "not read *with attention* ten pages," &c. It is curious that reading Mr. Beveridge's letter in proof, before I had noticed the Editorial note, I thought of adding almost word for word what the acting Editor had already added. What I actually said may be regarded as a comment in support of the Editorial note. I still consider that Mr. Beveridge has not caught the true meaning of Darwinism,—indeed so much is obvious. He says "slight variations are totally ineffective," and illustrates by an example utterly unlike those considered by Darwin, which are such as leave a balance of advantage in the struggle for life under complex conditions. Mr. Beveridge does not pretend to show that the length of his moustache would affect him unfavourably in this sense. Even his slower feeding might be advantageous, while the protection to him in breathing might be a matter of much greater importance. If men had to feed in haste, and the long-moustached could not get a sufficient supply, then—unless length of moustache gave some equal or greater counterbalancing advantage—the case considered by Darwin would arise. Long-moustached persons would be weighted in the struggle for life, and in the long run the small difference would tell. As for Mr. Beveridge's present letter it confirms my opinion that he has missed Darwin's meaning. Darwin certainly has nowhere abandoned, silently or otherwise, the belief that slight variations, when they affect, in however slight a degree, the *balance* of advantage in the struggle for life, will have a better chance of surviving, and will therefore in the long run be naturally selected. In the last paragraph of letter 1879 Mr. Beveridge showed that he had utterly failed to follow the reasoning which led Darwin to reject the doctrines of Lamarck and others in regard to evolution. He should compare the editions of Lyell's "Principles of Geology" preceding Darwin's work with those which followed that work, if he would find a striking illustration of the contrast which exists between the theory of natural selection and all former attempts to establish a doctrine of biological evolution.—R. P.]

SKIN-CASTING OF SNAKES.

[1907]—In reference to Dr. Hutchinson's letter (1886) on "The Skin-casting of Snakes," may I be allowed to say that last year I kept snakes, and had good opportunities of observing their skin-casting practices? One of them, indeed, "exuviated" no less than three times within a period of five months, and two others certainly twice. As I kept my snakes well supplied with food, possibly a somewhat rapid enlargement of their graceful persons caused them to outgrow their garments more quickly than usual; for I was much surprised at the frequency of their demand for new clothes. More than once I had the privilege of assisting at the ceremonial, not without earning, I trust, the gratitude of the snake. On such occasions, noticing that the skin around the jaws had cracked, and that the head was emerging—the two flaps of the skin turning backwards—I took the snake out of its box, and encouraged it to crawl through a sort of manual or digital tunnel, when off came the skin, neatly turning inside out as the reptile crept through my hand—the peeling process ending with the tail. In fact, the whole affair much resembled the drawing off of a stocking by turning it

inside out from the knee downward. In one instance the snake left the point of its tail in the old skin, owing to a pinch which it had uncomplainingly received a week or two before through my own carelessness. The wound soon healed, but a slight terminal bluntness afterwards distinguished the tail of that snake. I may mention that this snake (whom I named "Sarah"), though perfectly tame and gentle, and possessed of attractive and endearing manners, had a voracious appetite, and once or twice actually snatched a frog out of my hand. One day, after swallowing several efts for breakfast, she greedily bolted two large frogs. Sarah had literary tastes; or, perhaps, a turn for practical joking, for she would coil herself amongst the books on my writing-table, and then, when I began to write, unwind herself and crawl over my MS., seeming to take a pleasure in smearing and blurring the sheet. Another snake, whom I called "Tiger," was a splendid fellow, adorned with a bright orange ring and spots. When he first came into my possession he was very fierce, hissing and striking at my hand each time I approached him, though he never bit me; but with frequent handling and gentle treatment he became a very courteous snake—as tractable as Sarah, though perhaps not personally attached to me so decidedly as that graceful, but not brightly-coloured, lady. A foreign snake (with black-and-silver longitudinal stripes, and traces of a ring round its neck), which I bought at a shop in Seven Dials, after a season of comparative gentleness, became so irritable and savage (from disease—"boils and blains")—that I was obliged to kill it. Besides several large English Colubers, and the foreigners (also of the Colubrine family), I had for a time two Coronellas (from Suffolk); but as these refused to eat efts, and sand lizards (their proper food) were difficult to obtain, I gave them to the Zoological Society. These snakes were not particularly endearing in their ways, and were in the habit of biting my fingers, though without drawing blood. They displayed considerable "constricting" and climbing powers, needing very little help to enable them to creep up the perpendicular trunk of a large tree. I noticed that the first symptoms of approaching exuviation was a general dulling of the colour of the snake—the eyes becoming dim, then of an almost turquoise blue, the reptile, too, apparently losing its cheerfulness and getting into a depressed state. After some days the colour would brighten somewhat, the new skin perhaps beginning to show through the old, the eyes growing clearer, and the countenance, too, assuming a more hopeful expression. After a further interval, the loosening of the skin about the mouth would take place, and then, in a short time, by creeping amongst stones, bits of wood, &c., the creature would turn back and strip off its old covering, and emerge in brighter and more beautiful apparel, and, evidently, more cheerful spirits. The skins, when off, are quite colourless, and show no holes where the eyes were, but curious spectacle-like projections. The cast-off coats of my English snakes measured from 41 to 43 or 44 inches in length. I forgot to notice that Tiger and Sarah occasionally amused themselves (and me, too) by pulling off my spectacles. They accomplished this by creeping between my face and the glasses and so pushing them off. I may also mention that, years ago, I was savagely bitten by a very large English snake, the common "Coluber natrix Tropidonotus." The creature's teeth were certainly very sharp, and there was some amount of bleeding, but, beyond a little smarting of the wound, of course, no bad consequences ensued. C. H.

Aug. 25, 1885.

ULEY BURY.

[1908]—On a walk through Gloucestershire this week, I happened to pass over Uley Bury, which I see is mentioned in your paper of yesterday, so venture to forward you the following notes, though, like most tourists' notes, they are worth but little. The Bury is well separated from, and commands the surrounding hills. The summit is a tableland, partly under plough cultivation. The sides are very steep: on their edge is an earth parapet and single ditch. There are roadways on the south-west face and at the north angle, both fortified by out-works; that at the north angle has had special attention. This gate faces the road over Crawley Hill to Nailsworth, and is the easier way into the camp. As this road is a ridge-way, it is probably on a very early road track. The defences here are two parapets, their front elevation being like segments of two concentric circles; the north corner of the front and smaller one has been cut deeply into for stone to mend the roads. It does not seem to have been worked of late, and it is to be hoped it will not be again (for stone abounds here at the very surface), as the contour of this defence would soon be destroyed. The enclosure is about half-a-mile long on its longest side, and rather more than a quarter on its opposite side, its breadth being about one furlong. From the slightness of the parapet it seems to have been formed in pre-Roman times before the British found it necessary to make such formidable triple earthworks like those on Caer Caradoc and the Herefordshire Beacon. From its large size one would think that a considerable population from the surrounding fertile vales expected to find a refuge there in time of war. Cultivation has obliterated any signs of hut circles or barrows, if any existed, which make the fortified town on Midsummmer Hill so interesting.

Perhaps some one who has taken an interest in this hill will send you a more detailed account of it than these vague notes.

Aug. 22, 1885. E. COOK.

VERSATILITY.

[1909]—I fear that "Hallyards" has an uneasy suspicion about versatility in general, and his own peculiar form of it in particular. Surely I praised it highly enough! And he replies that I "insist on the man of one book." I have not "insisted" on him, but I infinitely prefer him to the "man of no books at all," who forms his own opinions (as the clever boy made the chest of drawers) "all out of his own head," who publishes by the dozen crude ideas on subjects to which the greatest intellects have devoted years of patient study. The man of no books at all is ever the most ready to "argue the point" on, say, the principles of evolution, before he even knows what evolution teaches (see letter 1872); he hears of the law of diffusion of gases, and instantly sees that it is "an influence counteracting gravitation as a universal law;" he solves the "problem of three bodies" off-hand, thus: one of them revolves round both the others, which place themselves in the foci of its ellipse—each, no doubt, flattering itself that it is the centre (I beg pardon, I should say "focus") of attraction. No wonder that after such a brilliant "happy thought" as this, the man of no books at all should "leave the dynamical question." He is prudent, for something astonishing must undoubtedly soon happen to this pair of jealous suns, and their eccentric satellite. Then, again, it is to the man of no books at all that we are indebted for such gems of knowledge as that the earth is flat, that the ratio of the circumference of a circle to the diameter is as $3\frac{1}{8}$ to 1, and generally that trained men of science are hopelessly wrong about everything. W.

["W." will excuse the omission of a part of his letter. Correspondents object to discussion not leading to any increase of knowledge, and "Hallyards" thinks himself unfairly treated if not allowed full swing in reply to all that may be said of him. In passing I note that the saying "Beware of the man of one book" had quite the opposite meaning to that imagined by "Hallyards." It was an expression of respect not of contempt. Beware of him for he will probably be strong and sure.—R. P.]

RELIGION OF THE ANCIENT MEXICANS.

[1910]—In reply to "Zeteo," letter 1877, he will find in Logan Mitchell's "Mythology Revealed," p. 101, a short *résumé* of the facts mentioned. This work was published first by Trübner, but there is a cheap reprint of it published at 63, Fleet-street. Full particulars can be obtained in "Narratives of the Rites and Laws of the Yncas," translated by Clements R. Markham, also "Commentarios Reales de los Yncas," by the Ynca Garcilasso de la Vega, Prescott's "History of the Conquest of Mexico," Prescott's "History of the Conquest of Peru," "Legendas Mejicanos, mentos y baladas del Norte de Europa," by F. M. Barcena, all published by Trübner. There are also the works by Acosta, Las Casas, Herrera, Sahagun, &c., containing full accounts.

The Spaniards were so much struck by the remarkable resemblance of these rites and doctrines with their own religion, that their priests attributed them to the machinations of the devil, and, for easily divined reasons, did all they could to prevent the facts from becoming generally known.

The principal features are: they represent their God under a trinity. Their sacred emblem is the cross. One of their trinity was crucified on a mountain between two thieves. Resurrection after three days. Ascension through the clouds. Expected return of their Saviour. They had the rite of baptism. The immaculate conception of a Virgin by the son of their God, &c. In short, all the leading features of Christianity and Buddhism, showing the common origin of "solar worship." F. W. H.

[1911] "Zeteo" [1877] will find the information he requires in "Hibbert Lectures for 1884. Religions of Mexico and Peru." By Albert Neville. C. CRIDLAND, M.D.

THOUGHT TRANSMISSION.

[1912]—I read with interest the discussion appearing in your paper on the above subject, and imagine the following will interest those interested. The other day I was thinking on a subject in which one of my comrades at another station was the principal. I went to instrument and "shook" instead of "calling in code." Immediately he answered. I asked a question, and then asked how

he came to answer correctly. "Why," says he, "I was thinking of the same thing myself, and walked to instrument, having an idea it was you, and you wanted my attention." Was it mere coincidence?

R. T. C.

INDIAN WASPS AND HORNETS.

[1913]—In my paper on Termites I did not include these Hymenoptera among our pests, because we are so familiar with the first, and generally find them so harmless, that we don't care for them.

On the other hand, our contact with the terrible hornet is fortunately so rare that we cannot class them as *general* pests. When that contact does occur, an *annus notabilis* is added to the calendar of the individual, if he survives.

Some years ago there was a controversy as to whether cell-building in hives and nests was centripetal or centrifugal. In a ruinous outhouse at Peshawar, I was able, in 1879, to satisfy myself of the latter; dependent from the roof, by a slender stalk, was the *solitary* paper cell of a female wasp, and she was proudly and tenderly overhauling its proportions with her anxious antennæ; while from the base of each side of the hexagon was already sprouting the germ of another cell, and so, under the fostering care of that lonely and indefatigable architect, the fabric reached maturity by diverging centrifugally from that focal cell.

The familiar English wasp is not met with out here; its place being taken by the yellow hornet, which thoroughly domesticates itself in our houses, and very very rarely assails, and then only in self-defence; the verandahs, bath, and storerooms are favourite attachments for the paper nests, which, when different families combine, become very large structures. During the breeding-season three or four males will secure points of vantage in your study, especially in the bookcases, and there each individual will take up a calling-spot; resting on his hind legs, with his fore elevated mantis-like, he keeps up a constant buzz, and surveys the scene, his antennæ moving anxiously in all directions. Woe betide the rival male who dares to invade that calling-ground!

But hush! here is a counter-buzz, recognised as female, and our beau is frantic with blandishments; he bows, stands on his hind legs, sings entreatingly—

"Won't you come in my pretty, pretty maid?"

while the lady approaches and retreats in true flirtish style; having sufficiently agonised the beau, she settles, and immediately becomes the centre of his most agonising attentions; he licks her all over, kisses her with his antennæ, smoothes her wings, and ends by fertilising her. His function being completed, he dies. She re-appears as that anxious and expectant mother in the Peshawar outhouse, and prepares her cradle for approaching maternity, the material being apparently semi-digested woody fibre. As each cell is completed, she enters backwards, and lays an egg, then fills up the nest with propolis, and arches it over with the same paper of which the cell is constructed.

This cell-building and egg-laying goes on until her ovaries are exhausted, and then she dies; so that each egg will pass into a larva, and that into a perfect insect without acquaintance or contact in any shape with the parent insects. Other wasps build their nests of mud, which you see them collecting in pellets from any spot where water lies—*e.g.*, the drain of your bathroom, or the neighbourhood of a well. These nests are only cylindrical tubes of various calibres, and with no attempt at geometric form. Some of these structures are plastered over with gum-arabic by their architects—why, I know not.

A very troublesome wasp affects ready-made holes of every description. In some localities, when the mosquito-curtain season is over, you will invariably find the female screws in the bed-posts utilised by these nuisances, the orifices being carefully plastered over and then whitewashed; or you may find the lock of a box or drawer which hasn't been opened for a week similarly stuffed up and whitewashed.

The final touch of whitewash is very wonderful, and is probably stolen from the walls. I say wonderful, because it is really a check upon the too rapid propagation of that particular species, for wherever you see the *white* mark, it is almost invariably attacked by master or servant, and the laboriously-collected contents dispersed.

But *the* most wonderful fact connected with these mud-building wasps remains to be told. We have seen that the common yellow wasp stores up propolis in her paper cells; not so the mason wasps, who fill up their nest-tubes, each with a different species of caterpillar or spider, each victim being in some wonderful manner anæsthetised and embalmed so as to afford *living* food to the enlarging grub.

Here is a case in point which we can watch as we write. The sudden appearance of a black, or very dark-brown, caterpillar-laden wasp draws our attention to its nest in the verandah, a series of mud cells opening upwards. As she alights we notice that she is on the back of the anæsthetised caterpillar, holding it in the grasp of all her legs. Quickly she manages to get the tail end of the caterpillar (in this case one of those green loop-walking larvæ of some ourapteryx moth) into the cell, emitting the while a curious hum, not alar, but thoracic or vocal, and then presses it in with her feet.

Flying away, she returns with a second loop-walker, which is similarly treated, then with a third and fourth, and the cell is full. It is then carefully plastered over, and a fresh one is begun. Eight to ten cells are thus laboriously completed and provisioned, and then that anxious and laborious mother yields up her life.

Some wasps bring brown, others green, spiders to their cells. In fact, each species sticks to its own caterpillar or spider—*i.e.*, a spider wasp will never bring in a caterpillar, and *vice versâ*. This I have established as an absolute fact.

Having reached thus far, let us review our position. On the one hand, the common yellow wasp builds her nest of paper, *always* of the same colour (dull white) and material, deposits in each cell an egg, fills up with propolis, and dies. Her offspring (taking one individual) has never seen its mother, never before seen the cell from which it emerges, can learn nothing from the outer world as to the material of its cell, nature of its food, or whence both are procured; yet it has no difficulty in procuring the proper kind of food, nor, when the fit time arrives, has it any difficulty in procuring the proper paper for its nest of cells, nor in moulding the latter with mathematical precision equal to that of its parent.

In like manner, on the other hand, the larvæ in the mud cell of this wasp-nest has never seen its parent, and beyond gorging on them in the darkness of its prison, has had no knowledge whatever, beyond their taste, of the green loop-walkers its mother has so carefully collected for it. Yet, when its time comes, it constructs a similar mud-nest to that of its parent, and stuffs it with similar larvæ, and no other.

Now, who taught these wasps the wonderful machinery of their cells, the astonishing processes of selecting particular kinds of animal food for each kind of cell, and of keeping such food alive, but anæsthetized, as long as it may be required?

The popular reply will be—instinct; but that tells us nothing. Why should a new-born wasp be better able to provide for itself than, say, a puppy, or even a baby—animals far higher up in the scale than itself?

By what process of development or natural selection has this marvellous vespa been perfected? for, mark, while it was developing, the loop-walker was undeveloping, *i.e.*, it was having its legs re-arranged, head and tailward, and from moving gracefully and equally, it had to adopt painful and laborious contortions, and thus become the fit and only food of a particular wasp.

Now for the proper hornets. Two species of these terrible insects are commonly met with, but fortunately both are comparatively rare. The lesser hornet is $1\frac{1}{2}$ in., and the greater 2 in. long; both species are brown, with a broad yellow band across the abdomen; both frequent unused buildings, tombs, and desolate ravines; the paper nests of the greater hornet are seen in the firs and cedars of the Himalaya, and many a traveller has jeopardised his life by foolishly firing at the nest. When attacked, your only chance of life is to sit down at once and cover yourself with a blanket. If you run, you are a dead man. Two cases in point. In the end of 1883, my friend, Surgeon-Major R. Jackson, A.M.D., in charge of the depôt up here was attacked by the lesser hornet; losing his presence of mind, he threw off his coat and ran for his life, which he lost in a few days by general blood-poisoning, having been stung from head to foot.

In 1861 I was showing the Arrah House to some friends, and, to get more light in one room, burst open a small window. In a moment I felt an agonising stab in my left temple, and just recognised my assailant as a greater hornet. Knowing what was coming, I made for home (about 250 yards distance) and ammonia. On reaching the threshold, I was paralysed, and couldn't move. Violent tremor succeeded, in the midst of which I was able to ask for a glass of port wine and swallow it. I was then laid on a couch, the tremor gradually ceased, and I fell asleep, awaking quite well, but in a profuse perspiration. A lump like half a pigeon's egg remained on my temple for some days.

Pachmari, July 11, 1885. R. F. HUTCHINSON, M.D.

ORGAN-PIPES.

[1914]—Of the Holmes organ in Battersea Palace I have read, "The biggest pipe, which weighs one ton, situated in the centre tower, is 38 ft. high, vibrating thirty-three times in a second, on sounding the lower C. The organ has five stops more than Haarlem, four more than Freiburg" (*Pall Mall Budget*, May 1, 1885).

I have always understood that the lowest pedal-pipe in an organ (thirty years ago) gave seventeen only to the second, and CCCC.

This would be two octaves below "the lower C"—*i.e.*, C below the bass lines.

I was lodging ten years ago at No. 1, Gloucester-terrace, Campden-hill. The rail passes nearly beneath the house, and there is an open part of the line behind the house. Sometimes—not after every train, but after few—I used to hear, after the clatter and roar of the train had quite died away, a faint sound, so horribly low that I was fain to stop my ears, fearing some injury. It occurred to me, on thinking, that this sound must be the note of the tunnel, considered as an organ-pipe. How many vibrations would that give? The rarity of the occurrence I conjectured to arise from its vibrating only when two trains chanced to pass each other exactly there.

Is there any probable determination of the musical value of the grunt of a very fat hog (not, of course, its value to an *impressario*, though I *have* heard a wild tale of an Admiral, who, lacking a band, and possessing a lot of pigs, had them ranged in the order of their pipes, and then played like musical glasses)? HALLYARDS.

ANT-ACIDS.

[1915]—I have just made a curious discovery. Writing in the fields, as usual, and over-run by smallish black ants, I smashed one in my fingers, being very fond of the smell of formic acid, found in them only (which shows how very human I am, for it is the proper sauce of man—the Maoris always stuffed long pig with ants before roasting). To my surprise, the smell was that of a first-rate fresh-cut lemon. I tried another; same result. I suppose hence that this species is full of *citric* instead of formic acid.

After a few minutes my fingers still have a lemony smell, but not so marked as at first. HALLYARDS.

MUNCHAUSEN REDIVIVUS.

[1916]—"A curious circumstance once happened to me at Pulney Loch. One of my sons threw a live mouse into it, when a large trout took the mouse down immediately. The boy told me what had happened; so I took my fishing-rod, which was leaning against the house, down to the loch, and put a fly on. At the very first cast I hooked a large trout, landed it, and laid it on the walk. In two seconds the mouse ran out of its mouth, and got into a hole in the wall before I could catch it."—W. Scrope's "Salmon-Fishing."

"It is a sign of narrow-mindedness to be incredulous," remarks the *Saturday*. There is in the story of Jonah nothing more intrinsically incredible than in this of the mouse. It teaches that a small mammal may live, without syncope, in the maw of a fish for a much longer time than it would live under water, or, at least, seem to live. Now, in 1879, a woman was recovered at Paris after a *twenty-four* hours' apparent death by drowning, through the incessant (and, one would say, insane) efforts of a doctor and a druggist. Given a man (of the old, tough type, now extinct) in the maw of a *mammal*, kept warm, resisting through his life the gastric juice, and receiving air as frequently as the mammal itself, and there is no impossibility in his maintaining this position for three times twenty-four hours. If he thus remained, resisting digestion, and probably not quiet, it is certain he would presently be vomited up, like any other tough morsel. A boa swallowed its blanket once, and it was rejected after (I think) a month, with all the nap digested off it. Experts were of opinion that, when the *Captain* foundered, asphyxia would not finally triumph before the end of twenty or thirty minutes. This is perhaps the saddest outcome of the "*æs triplex*" of the first mariner.

Captain Lloyd, in his "Field Sports of the North of Europe," says that eagles sometimes seize pike, and are dragged down and drowned by them, being unable to disengage themselves; but this acquisition of an imperial crest is by no means a feather in the pike's cap, for, of course, they can't swim with any speed, so handicapped (or unhandicapped), and are forced to skirt the surface. The eagle's skeleton, grown green with weed, thus flits o'er the waters of the lake, and is taken by the natives for the water-sprite—a harbinger of misfortune. A pike thus crowned was shot. Three cases are also given where an eagle stuck one talon into a root, and the other into a salmon, and, the fish darting off, was forthwith split from rump to beak. Note the immense strength of the bird's legs, which one would suppose would give before his body. A similar fate had nigh befallen me once. Stepping into a boat, the shore-foot got between two stones and the other entangled in a rowlock; had the forces at work been disproportioned, the result would have been dislocation of the hips or knees.

On entering one day the coffee-room of the Star and Garter, at Kew, I saw a cat with a canary in her mouth. I immediately went for the cat, who, strange to say, did not run, though two doors were open; put my thumb on her throat and delivered the bird, which an hour after was no worse. HALLYARDS.

LETTERS RECEIVED AND SHORT ANSWERS.

HALLYARDS. You are mistaken. There is usually more aqueous vapour in hot than in cold air. It is this capacity for receiving aqueous vapour which gives to hot air its drying power. As you point out, a committee of washerwomen would probably agree with you: but after you had studied the matter you would not agree with *them*. As to "the waters above the earth," I think you are probably right. People in old times found that water came down from the sky, and so—probably—supposed there was a reservoir up there.—Doubtless there were builders before the days of the pyramid.—I have not "stated as a fact that the moon is a dead world": I think it likely she is,—that is all.—With regard to corruptions of English, the subject is one which, if continued, would require that our correspondence columns should be left open. Now after the end of September there will be neither correspondence nor replies to letters received. Letters written by those who know may either appear in article form or be made the subject of paragraphs. But KNOWLEDGE will be a monthly sixpenny magazine of science, literature, and art.—Your letter about disagreeing Doctors will not "work the oracle": I have seen neither the book nor the review, and therefore cannot say what either Mr. Tait or the reviewer meant.—HUNDREDWEIGHT. "Farther from" was intended. See "Hallyards'" letter, and my "Gossip."—R. LEWINS. We must beg to be excused.—W. N. MACARTNEY. In my lecture on "The Sun," I usually dwell on the terrestrial effects of solar rays. Also in my lectures on "Life of Worlds" and "Origin of Solar System."—F. J. BURGOYNE. Your society's name would then be first on that list, which is as yet not opened.—C. MOON. Of course the difficulty is that most mathematicians do not know about the practical wants of seamen in such matters.—F. C. W. Begin with the "Origin of Species"—then the "Descent of Man."—R. S. TARR. Found nothing enclosed.—T. B. S. I differ from you, but I have no difference with you. When a man says, I differ with you, he does not mean I have a difference with you, but I differ from you. That a man may differ from another in height, colour, &c., gives no reason why he should not also differ from him in opinion.—BORDERER. You will find the lines in Anstey's translation of "Faust." As you say, they have been given in KNOWLEDGE, so space must not be used in repeating them among replies.—THOS. SMITH. When has man been regarded as *not* an animal? If you ask what difference there is between man and other animals, I point out that man speaks, reasons, and is moved by feelings and emotions either not experienced at all by other animals or not in the same degree. If a man is dumb, idiotic, and brutal, he is not in these respects unlike other animals—and I must go back to some such definition as Plato's, Man is a featherless biped, though even that was spoiled when a plucked fowl was thrust before Plato's pupils. In short, I expect you know as well as I can tell you in what man differs from other animals.

Our Whist Column.

BY "FIVE OF CLUBS."

BRILLIANT BUT NEEDLESS STRATAGEMS.

MANY seem to imagine that the Whist games which appear in books and papers are necessarily examples of perfect play, especially when those engaged are good players. As a matter of fact this is far from being the case. Often in the exercise of his best judgment, but on the spur of the moment—for at Whist a player is not permitted to enter on prolonged calculations—even the finest player does what he sees afterward to have been ill-judged. The finest player makes the fewest mistakes,—that is all that can be said.

But apart from this we sometimes find that in games specially selected as examples of fine play,* the very stratagems by which it seems at a first view as though success had been forced, have been in reality unnecessary and even ill-advised. I know no better example of this than the game from Cavendish's treatise on Whist, to which I referred last week—a game published by him as a fine example of a double *coup*,—a *coup* in throwing the winning card, and then the *grand coup* in using a surplus trump to capture

* Cavendish, in his review of my "How to Play Whist," remarks on mistakes in some of the games. Representing actual play, they are of course not free from mistakes; but, after all, the worst fault he notes is that in some games the antepenultimate is played, in others not. He wants "uniformity above everything." But as some players do, while others do not, play by system, games honestly taken from real play cannot be absolutely uniform. It is a much more serious fault when, as in Pole, five games, and in many of the thirty-nine in Cavendish, bad play is selected for commendation. The game dealt with this week may be cited as an "awful example."

partner's trick,—in perfect unconsciousness that this brilliant play was unnecessary and dangerous. The game appears in my work, "How to Play Whist." But readers who have written asking me where it is unsound may take interest in studying it with the accompanying series of notes :—

THE HANDS.

B { H (*trumps*). A, Q, 10, 6. D. A, 3
S. Q, 10, 8. C. A, K, Kn, 8. }

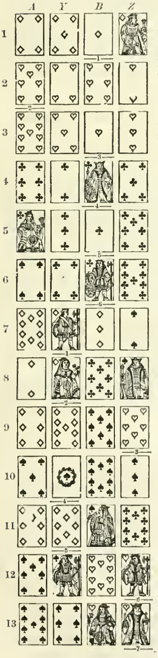
Y { H. (*trumps*) 5, 4.
S. A, Kn, 6.
D. Q, Kn, 9, 8, 5.
C. 4, 3, 2.

B
Y Z
Tr. H. 8
A leads.

K, Kn, 8, 3, 2.
K, 3, 2.
K.
10, 9, 7, 5. } *Z*

A { H. (*trumps*) 9, 7. D. 10, 7, 6, 4, 2.
S. 9, 7, 5, 4. C. Q, 6 }

Score :—*A-B*, 4 ; *Y-Z*, 4.



NOTES ON THE PLAY.

NOTE.—Card underlined takes trick, and card next below leads next.

1. *A* leads penultimate of his long weak suit. As he has no re-entering cards, except the Queen of Clubs, which is very likely to fail him, the case falls under Pembridge's rule that a long weak suit should never be led from, without strength to bring the suit in. Especially is this bad at the score of "Four all." *A* sees that Queen lies with *Y*.

2. *B*, knowing that *Z* has no more diamonds, while he has but one left, can safely infer that *A* led from five. If so *Y* cannot be signalling, for the Two is the only card less than the Four (except the Three, which *B* holds). He sees, therefore, that *A* has the Two, probably, and three more. *Z* may be signalling from King, Queen ; but this is less likely.

3. *A* can count nine trumps at least between *B* and *Z*. *Y* can hold no other trump but the Five. The return of the trump lead up to *Z*'s strength was therefore bad play, especially at the score. After trick 3, *B* and *Z* know that all the remaining trumps lie between them (note the trump card).

4, 5, 6, 7. *B* makes all possible Club play, and leads his partner's suit.

8. Here *Z* (Cavendish himself, the hero of the game) plays badly! It is obvious that if the enemy hold the Spade Ace the game is lost for *Y-Z*, let them play how they may ; for *A-B* want but one trick to save and win the game. Therefore *Z* thould have played as if he saw the Ace in *Y*'s hand. He should have trumped his partner's winning Diamond, led his Spade King, and then the small Spade. He was sure of the game this way, because, after round seven, he knows *Y* holds the Diamond Nine. On this course *Z* would still have had the satisfaction of playing the *grand coup*. It would have done equally well, however, to play the quiet game, and discard the Club Ten.

9. Here again Cavendish played badly. By trumping his partner's winning Diamond he makes the game depend on partner's holding the next best Diamond. By discarding the Club, and leaving partner to go on with the next Diamond (losing or winning), *Z* would have held the game sure. But

11. Luckily *Y* holds the winning Diamond ; so that,

12 and 13. Leading up to *Z*'s tenace, *Y-Z* win the trick and the game.

"Cavendish" was *Z* in the above game, and "Cavendish's" father, a good player of the old school, was *B*. In "Card Essays," Cavendish gives an amusing account of the game, and of his father's mixed feelings respecting the result—pride in his son's play, and annoyance at defeat. He assumes, however, that the *grand coup* at trick nine won the game. ("Of course it did, of course it did," his father grunted); while James Clay greatly admired the throwing away of Spade King. Yet in reality, as Mogul long since showed, the game could have been more safely won without these brilliant strokes, and was endangered by the bad play which made them necessary.

Thus, suppose the game to have proceeded as far as trick six, *A-B* having won all six tricks, and wanting but one to win. At trick seven, Cavendish was perhaps right in omitting to ruff, as the game was lost if *Y* had not the winning Diamond, and withholding the ruff gave *Y* a chance of making the tenace if he had it. Still the game would have been easily won if *Z* had ruffed at trick seven, leading then Spade King, then small Spade, and leaving his partner, after winning with the Spade Ace, to play his winning Diamonds, which *B* dare not ruff. But at trick eight, both *Y* and *B* play badly. *Y* should have led the lowest of his head sequence of Diamonds, so that *Z* might ruff (for *Y* knows that unless *Z* holds three trumps the game is lost); and whether *Y* had led his lowest or highest Diamond *Z* should have ruffed. The tricks would then have fallen as follows :—

8th to *Z*'s small trump ;
9th to *Z*'s Spade King ;
10th to *Y*'s Spade Ace ;
11th to *Y*'s Diamond Nine ;
12th and 13th to *Z*'s major tenace in trumps ;

all this is sure, because *A* certainly does not hold the Diamond Nine (see trick 7).

The game is also sure (apart, of course, from the enemy holding the Spade Ace, in which case nothing can save it) if *Z* discards Club Ten at trick 8. The tricks would then fall as follows :—

8th to *Y*'s Diamond Queen ;
9th to *Z*'s small trump ;
10th to *Z*'s Spade King ;
11th to *Y*'s Spade Ace ;
12th and 13th to *Z*'s major tenace in trumps.

This, undoubtedly, was *Z*'s proper course, after *Y* had erred by leading his Diamond Queen.

After throwing away the Spade King, and with it the only sure paths to victory, *Z* again played badly in the *grand coup* at trick 2. It was not only unnecessary ; it endangered his game. If *Y* had not held the Diamond 8—and there was nothing to show he held it—the *grand coup* at trick 9 would have lost an otherwise sure game. The game should have closed as follows :—

	A.	*Y.*	*B.*	*Z.*
9.	D6	D9	S8	C10
10.	D7	D8	S10	H8
11.	S5	SA	SQ	S3
12.	S7	SKn	H10	HKn
13.	S9	S6	HQ	HK

If *Y* held the losing Diamond, the game would have been sure on this line, while lost on the other.

I believe that in a great number of cases where the *grand coup* is triumphantly played, the necessity for playing it has arisen from a previous blunder or two, as in this case. Of course, on every line by which the above game might have been won, the *grand coup* must have been played. But this is simply because *Y* holds all the best Diamonds after trick seven. For anything *Z* knew up to trick ten, the extra trump would capture the enemy's winning Diamond, not *Y*'s.

W. F.—A second solution is not usually regarded as rendering a problem "more interesting and instructive." There is, however, no second solution to the six-trick double-dummy problem. If *A* opens with C 10, taken by *B* (by the way *Y* must play the knave, or *B* can let *A*'s 10 take the trick and a third solution of the problem would come in), following with Spade 7, *Z* discarding Diamond 7, *Y* must not unguard his Diamond Knave ; he unhesitatingly discards a Heart, for, as against the Ace and King, *Y*'s Hearts have no value. Now, let *B* lead as he may, *A-B* lose one trick, either to *Y*'s Club 8 or Diamond Knave.

Our Chess Column.

By Mephisto.

THE CENTRE GAMBIT.

Illustrative Game No. 9.

We give here a specimen of Black's defence of 4. P to KKt3 in this Opening. It will be remembered that we gave preference to the defence of 4. Kt to B3.

Game Played in the Vienna Tournament of 1882.

White. M. Tschigorin.	Black. Capt. Mackenzie.	White. M. Tschigorin.	Black. Capt. Mackenzie.
1. P to K4	P to K4	16. Kt to Q4 (*f*)	Q to Q2
2. P to Q4	P x P	17. Kt to Kt5	P to QB3
3. Q x P	Kt to QB3	18. Kt x P (ch)	K to B2
4. Q to K3	P to KKt3	19. R x Kt (*g*)	P x R
5. B to Q2	B to Kt2	20. B to Kt5	Q to K3 (*h*)
6. Kt to QB3	P to Q3 (*a*)	21. Q to B3 (ch)	K to Kt3 (*i*)
7. P to B4	KKt to K2	22. R to K sq. (*j*)	K x Kt (*k*)
8. Castles	B to K3	23. R x Q	P x R
9. Kt to B3	Q to Q2	24. Q to K3 (ch)	K to R sq. (*l*)
10. Kt to Q5 (*b*)	Castles QR	25. Q to R3 (ch)	Kt to R3
11. B to B3	B x B	26. B x Kt	P x B
12. Q x B	Kt to QKt sq. (*c*)	27. Q x P (ch)	K to Kt sq.
		28. Q to Kt6 (ch)	K to B sq.
13. Q to R3	B x Kt (*d*)	29. P to QKt4	KR to K sq.
14. P x B	Q to B4	30. Q to R7 (*m*)	P to K4
15. P to KKt3	Kt x P (*e*)	31. P to Kt5	Resigns

Notes.

(*a*) Judging from experience gained in our previous games, we may assume that in all cases it is better for Black to play P to Q4 in this Opening, especially so when the Kt is on QB3, B on Q2, and Q on K3. For that purpose it would have been better for Black to play KKt to K2, followed by Castling, &c.

(*b*) A very good move, and showing the importance of occupying that square for Black. White makes room for his B on B3. Black cannot take the Kt, for after P x Kt the Black QKt is driven out of play.

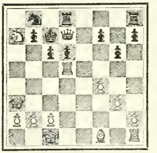
(*c*) Black must make room for his Q, which is threatened with Kt to B6. To play B x Kt would give Black a very awkward game.

(*d*) Black should only have done this as a last resource. We do not see any very great objection against P to QR3, except that Black would not be able to dislodge the Kt any more by P to B3.

(*e*) An error which costs Black a piece. The Q only affords precarious protection to the Kt; there are several ways of proceeding, 16. Kt to Kt5 followed by B to R3 looks tempting, but Black would answer with 16. Kt x P.

(*f*) Well played, with a view to Kt to Kt5.

Black.



White.

(*g*) A masterly conception, and, as will be seen, perfectly justified by the result.

(*h*) If Kt to B3, White plays Kt x Kt, followed by Q to R7 (ch), &c.

(*i*) It would be equally bad to play Kt to B3. 22. Kt x Kt, P x Kt. 23. Q x P (ch), &c.

(*j*) With the intention of playing Q to K4 (ch), followed by R to K3 and B3 (ch), &c.

(*k*) Taking his last chance.

(*l*) In reply to P to Kt3, White plays Q x P.

(*m*) An excellent move, Black now cannot move either Rook, and the P can go on to Queen.

EXPERIMENTING IN SERIOUS GAMES.

Two players sat down to play a game. The first player began with 1. P to K4, the second player then lapsed into deep thought and kept his opponent waiting for his reply. "Do you want to invent a new move?" asked A impatiently. "Yes!" replied B. "Then," responded A, "I wish you would do it at home!"

The same might be said to those players who jeopardise serious games by trying experiments in the Opening. Nevertheless it is a well-known fact that many players (and sometimes in spite of all resolutions to the contrary) will test some fancied line of attack or defence on important occasions, with the result that sometimes the experiment brings them anything but profit. Thus Steinitz lost several games through that reason in the London Tournament of 1883, as well as Zukertort, although the latter only kicked over the traces of Chess prudence after he had won the first prize. Winawer, more than any other player, creates for himself unnecessary difficulties by constant deviations from recognised modes of play. A brilliant exception from the general fate befalling players experimenting in the Openings, is shown us in the Chess career of Louis Paulsen. He contributed to, and extended our knowledge of, the Openings, more than any other living player, mainly by experimental play. He was, however, a successful player in his time. That may be owing to the fact that in the first instance he was purely an analytical player of very high order. Secondly, play in his time was by no means so hard and stubborn as it is now.

The following remarkable calculation has been made by Herr Richard Schurig, Professor of Mathematics, and also a strong Chess player. He says: "The numbers of different positions which the thirty-two chessmen may form on a board of sixty-four squares, reaches the enormous sum of fifty-two figures, that is—

7,534,686,312,361,225,327,000,000,000,000,000,000,000,000,000,000,000

Some idea of the vastness of these figures may be formed from the following comparison. Suppose we have to deal with microbes of $\frac{1}{1000}$th of a millimètre in size, therefore a cubic millimètre would contain 1,000 millimètre of these microbes. A globe containing all the microbes represented by these fifty-two figures, would have a diameter of one-and-a-half times as large as the distance from the earth to the sun. But if, in addition to this, we also take into account the different positions which may be formed by the taking of pieces till the Kings only remain on the board, then the above comparison does not in the remotest degree suffice to give an adequate idea of the vastness of the possible numbers.

Contents of No. 200.

NOTICES.

Part XLVI. (August, 1885), now ready, price 1s., post-free, 1s. 3d.

Volume VII., comprising the numbers published from Jan. to June, 1885, now ready, price 9s.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, SEPTEMBER 11, 1885.

Contents of No. 202.

A NEW STAR IN A STAR CLOUD.

By Richard A. Proctor.

The discovery of a new star in the midst of the Great Nebula in Andromeda must be regarded as one of the most remarkable astronomical events of the age. It is true that great changes have ere now been recognised in stars lying within nebulous clouds. The star Eta Argûs for example, which lies in the midst of that wonderful mass of luminous gas called the Keyhole Nebula in Argo, has changed so marvellously in lustre since it was first catalogued as a fourth magnitude star as to present a case corresponding so far as the star is concerned with the sudden appearance of the new star in the Andromeda Nebula. For Eta Argûs sank from the fourth magnitude to the sixth, then rose rapidly to the second, and after remaining for some time at that magnitude increased almost suddenly in splendour until it rivalled Canopus and was surpassed only by Sirius. Undoubtedly to an observer set at such a distance that Eta Argûs when thus resplendent would have appeared only as an eighth magnitude star, like the new star in Andromeda, Eta with its present light of a sixth magnitude star would be altogether invisible. So that viewed from that imagined distance Eta Argûs when it rose to its greatest splendour would have appeared as a new star, and as it faded out of view would come to be regarded as having been but a temporary star.

Again the star which appeared in Cygnus in 1876 must be regarded as a star which had suddenly shone out in a nebula, although no nebula had been known where the star appeared. For when that star had disappeared there still remained a blue planetary nebula in the place which the star had occupied. And this nebula was and is so faint that one can readily understand it having escaped notice before. No one, I imagine, can doubt that the nebula which is seen there now existed there before the star appeared.

The stars in the great Fish-mouth Nebula in Orion exhibit also a certain degree of variability, which, though not so striking as the appearance of "new stars," is in reality a phenomenon of the same sort. For every so-called "new star" may be regarded as a variable of an unusually irregular kind.

But in all these cases the star which shone with variable lustre, or which for a time appeared as a new star, has been in the midst of a gaseous nebula. The great nebula in Andromeda has always been regarded as a stellar nebula, although it has never been resolved into stars. Under spectroscopic examination it presents the rainbow-tinted streak crossed by absorption lines which indicates the existence of glowing solid or liquid or highly-compressed vaporous matter shining through absorptive vapours. I remember Dr. Huggins describing the spectrum of this object to me, during a visit which I paid to his observatory in 1866; and he then said that the spectrum differed only from that of a star, in being rather sharply cut off at the red end, as if through the action of vaporous envelopes more powerfully absorptive of red light than the vapours around our sun and most other stars.

In a rather carelessly-written paragraph in the *Times* of Saturday last, manifestly by a person not well acquainted with astronomical facts, the new star is spoken of as if it gave support to Laplace's nebular theory. In reality the appearance of the star is most strongly opposed to that theory, for the simple reason that all the processes involved in Laplace's nebular theory are slowly-acting ones, while the appearance of a new star where a star had not before been visible, signifies events of a catastrophic nature. Moreover the theory of Laplace, in the form in which it was presented, cannot be maintained by any one acquainted with the laws of physics. A vast disc of gaseous matter, extending beyond the orbit of Neptune, but containing no more matter than there is in the whole solar system would not have the slightest cohesion among its various parts. To conceive of it as rotating like a single mass is to imagine the impossible. One may say indeed of Laplace's nebular hypothesis—which was very properly regarded by himself as but a guess—that astronomers suppose it physically possible and physicists suppose it astronomically possible: but no one who combines a knowledge of both astronomy and physics can accept it in the wide generality of its original form.

What the new star really does throw light upon, and light of a very clear and unmistakable sort, is not the theory of the solar system, but the theory of the stellar system—that grand gathering of stars, star-clusters, star-clouds, and star-streams, which we call the galaxy.

If there was one member of the family of nebulæ which was still supposed to remain possibly an external galaxy, after all the evidence which had been collected to show that nebulæ belong to our own galaxy, it was the great nebula in Andromeda,—the transcendently beautiful queen of the nebulæ as the old astronomers enthusiastically called it. Mr. Herbert Spencer observed as far back as 1859 or 1860, in his fine essays on the Nebular Hypothesis in the *Westminster Review*, that the theory according to which numbers of the resolvable nebulæ are external star systems is absolutely untenable. He pointed to this fatal objection, that Sir William Herschel's most powerful telescopes failed to resolve the remoter portions even of our own galaxy. How then could they—or indeed in many cases much weaker telescopes—by any possibility resolve galaxies lying far beyond its limits. A resolvable nebula which has an apparent greatest diameter of a quarter of a degree of arc, would be a very large one indeed; yet even one of that apparent size must lie at a distance exceeding its own diameter about 230 times, and exceeding

therefore (supposing that nebula a galaxy like our own in size) the distance of the outskirts of our galaxy from us, more than 450 times. This would correspond to a diminution in the lustre of individual stars more than 200,000 times. Now Herschel had to withdraw from the survey of the remotest parts of our galaxy, or at any rate the least resolvable parts (for my own interpretation of their irresolvability does not assume great distance as a necessary point), satisfied, as he said, that those depths are unfathomable. Irresolvable nebulosity foiled his most powerful telescopes, within the limits of our own stellar domain. How preposterous then, when considered a little, the belief that the same telescope which failed to resolve the outskirts of our own galaxy, can bring into view individual stars having less than the 200,000th part of the light of those remoter suns of our stellar system.

Mr. Herbert Spencer pointed out another fatal objection, in Sir W. Herschel's own account of the arrangement of the stellar and nebular groupings. For Herschel said that whenever he found his star gauges running poor, he would call out to his elder sister, Miss Caroline Herschel, who acted as his assistant, "Prepare to write, nebulæ are about to appear." This peculiarity of arrangement by which nebulæ fit in where stars are sparsely strewn, and *vice versâ*, must be regarded as proof positive of the association between nebulæ and stars. Nebulæ must belong then to our galaxy.

I myself collected some forty pieces of evidence as to the structure of our galaxy, by which as I believe the old-fashioned theory (in favour of which not a single direct argument has ever been adduced) was shown to be absolutely untenable. I may remark in passing that I propose to publish in the first monthly number of the new series of Knowledge a letter which I addressed to Sir John Herschel in 1870, wherein the greater number of the arguments on which the objections to the old theory are based were briefly indicated. In the second number of that series I propose to publish his singularly interesting reply to that communication. I feel that the time has come to make known precisely how that great astronomer viewed the questionings then being addressed to the theory with which—not quite correctly—his own name and his father's have been associated.

But while Mr. Spencer's objections (of themselves) sufficed to demonstrate the utterly untenable nature of the theory of galaxies of stars external to our own stellar system; and my own more laboured gathering of evidence on the subject should have left no doubt, even in the minds of those last ready to recognise the force of reasoning in such matters, the great nebula in Andromeda was in some degree outside our evidence.

The Andromeda nebula is not gaseous but manifestly stellar; yet it has not been resolved into stars. Nor had it been possible to show how far the nebula was from resolvability. Some, using very powerful telescopes on the nebula supposed they had come very near to resolving it into discrete stars; but they could not feel sure on such a point. For anything yet shown, telescopes a thousand times more powerful than the great Rosse telescope (imagined for the moment as perfect in defining power) might have failed to resolve the Andromeda nebula into stars.

Therefore Mr. Herbert Spencer's first objection, fatal against all resolved or partly-resolvable nebulæ, had no *fatal* force (it had considerable force however) against the Andromeda nebula. Of course the other objection had no force at all if this nebula is once regarded as exceptional. Among all my own objections against the theory of external galaxies, few had much force against the Queen of the Nebulæ, and certainly none were absolutely decisive against this great agglomeration of unquestionably stellar material being an external galaxy.

Now, however, it need hardly be said, the question is disposed of. A star-cloud cannot possibly be an external galaxy resembling our sun if there can appear in it suddenly a star where no star had before been seen. Were the Andromeda nebula such a galaxy the change which has recently taken place in it (or to speak more precisely, the change of which the light-brought news has recently reached us) would correspond to such a change in our galaxy as would alter its whole character. A star millions of times larger than any orb in our galaxy would have to be present in it—to begin with—and then after being so dull as to give no more light than an ordinary sun—would have to blaze out suddenly with hundreds of thousands of times as much light even as the splendid Sirius pours forth, to produce such a change of aspect in our galaxy, supposed to be seen from the distance of the Andromeda nebula, as has actually taken place in that star-cloud.

The theory that the star-clouds, or any of them, are external galaxies has received a death-blow. This is not saying it was not dead before. The blow may be such a one as Falstaff gave the dead Percy: but no one can mistake its force. With this new wound the theory has no longer even the semblance of life, and will possibly disappear ere long from those cemeteries for defunct theories, the text-books!

SELF-INHUMATION.

A CONTRIBUTION TO HUMAN HIBERNATION.

By Dr. W. Curran.

STORIES appear every now and then in the papers about priests and other holy members of the Hindu or Mahommedan religions burying themselves alive, for penitential or spectacular purposes, in India. That many of these are exaggerated—*crescunt eundo*—while others are as undoubtedly true, goes without saying, and the *rationale* of all is so little understood in these colder latitudes that it may be as well to say a word or two, by way of introduction to what follows, about it. These practices would, indeed, be otherwise unintelligible, so *outré* or impracticable do they appear, and the atmosphere of India, charged as it is with miracle and fable, is peculiarly suited for displays of this kind. Vicarious suffering or expiation has, moreover, been ever a favourite mode of currying favour with the Deity in that country. Pilgrimages and offerings of all kinds are just as acceptable at the shrines of Allah and Budh as they are at those of Vishnu and Siva, and self-destruction, for an incurable malady or other deprivation or calamity, is expressly sanctioned in one of the holiest of the Hindu Shastres.*

"The invasion of the Punjab by Alexander in B.C. 327

* "The Bramah Pooranee expressly directs as follows," says Ward in his view of the History, Literature, and Religion of Hindoos, p. 125:—"Let the man who is afflicted with a grievous and incurable disease enter a burning fire, or procure his death by starvation, or by plunging into unfathomable waters, or by precipitating himself from an eminence, or by ascending to Paradise by a respectful pilgrimage to the Himalayan mountains. Whoever relinquishes life or destroys himself (under these circumstances), that high-minded person shall receive a great reward in a future state, and shall not be considered a suicide. Even although he may have been a great sinner, he shall meet with supreme bliss in Paradise."

is," says Mr. Talboys Wheeler,* "the first event which brings India into historical relations with the outer world," and one of the most interesting episodes of this relationship was Alexander's friendship for the Brahmin, Kalanos. This holy man became so attached to his great master that, having probably through this attachment broken his caste obligations or incurred the displeasure of his bigoted associates, he volunteered to accompany him on his return to Greece. But he never reached his destination, for finding the burthen of age or of travel too much for him, or being rather oppressed by some painful disorder, he sought, and obtained, permission to take away his own life. Arrian assures us that, accompanied by his friends, he deliberately mounted a funeral-pyre that was erected in sight of the army and, setting fire to this with his own hands, he perished in the flames. Grant Duff † ascribes a similar disregard of death or dread of suffering to his friends the Mahrattas, and General Sleeman ‡ knew—circiter annis 1828-30—"a wealthy Hindu gentleman who came a distance of two hundred miles or more to the banks of the Nerbudda for the express purpose of drowning himself in that sacred stream. He was accompanied by a large retinue of friends and relatives, of whom, after the usual ceremonial observances of his caste and creed, he took an affectionate farewell. He then entered the boat that took him into the deepest part of the river, and having loaded his body with sand, as a sportsman who is required to carry weights in a race loads himself with shot, he slipped into the water and disappeared."

"Many poor men," he adds, "do the same every year when afflicted by any disease that they consider incurable," and the so-called "Ghât-murders" of the Ganges and the Hooghly are relics of the same tradition and spirit. So also were Suttee, the swinging from hooks through the loins, the tongue-piercings, the live-burials, and other horrible tortures of that kind that were formerly so common in that country. The friends or relatives of the doomed devotee, being unable to afford him the luxury of a boat to carry him into deep water, placed him on the margin of the river, and having stuffed his mouth with mud in the usual orthodox fashion, left him to die as best he may. And so determined on self-destruction were these infatuated victims of superstition, that they bitterly resented any attempts that might be made by outsiders for their rescue. Nay, even they subsequently reproached § their deliverers with having been the cause of their disgrace in this world and ruin in the next; and I believe myself that were we to withdraw from India to-morrow, all these frightful practices would be revived again there.

I am glad to find this, my opinion, confirmed by so competent a witness as Mr. James Fergusson, D.C.L., &c. Discussing the relationship of some of these practices to the monoliths, &c., he is describing, he says ("Rude Stone Monuments," p. 38) that "even now, with all our colonisation and civilising power, we have had marvellously little real influence on the native races (of India), and were our power removed, all traces (of our rule) would rapidly disappear, and the people would revert at once to what they were, and act as they were wont to do before they knew us" at all. He acknowledges further, on p. 459, that "the Bhêl, the Cole, the Gond, the Todd, and other tribes remain as they were, and practise their own rites and follow the customs of their forefathers as if the stranger had never come amongst them," and he adds (p. 461) that "if our strong repressive hand were once removed, it cannot be doubted but that the human sacrifices—previously referred to—would be instantly resumed." So would suttee, female infanticide, ghât-murders, and self-inhumations, for the spirit that underlies the whole fabric and framework of what is—derisively or facetiously—called Indian civilisation, *alias* superstition glossed over, not buried, is not dead but sleepeth; and the same may be said of other primitive or semi-civilised tribes and races, *tantum (potest) religio suadere malorum.*

With regard to the phenomena set forth in the stories here referred to, I may be permitted to say *in limine* that I inquired into them on the spot, with this result, that the few Europeans who had heard of them disbelieved them; while, as regards the natives they were, as might be expected from their surroundings, &c., divided on the point. The Mahomedans, influenced as they inevitably must be, by the extraordinary ecstatic feats * of their own holy men, did not actually regard such a disposition of the body as this kind of interment implies as necessarily incompatible with its vitality. They were staggered, however, when confronted with the facts of the case as these were translated by me for them, and all I could get from several of them was a, "Shaind Sahib, perhaps so, sir, there is no knowing." There is, indeed, no knowing, and as to the Hindus they all accepted these narratives without hesitation or demur. But then the mythology of the Hindus is wilder and madder than that of Olympus, and thousands, millions amongst them believe that when the mystic union of the Yogi of the period is effected with Sivà, he "can make himself lighter than the lightest substance, heavier than the heaviest; can become as vast or minute as he pleases; can traverse all space, animate any dead body by transferring his own spirit into it; and, finally, can become acquainted with the past, the present, and the future." † What a treasure such a Yogi would be, to be sure, in a London newspaper office in the dull season, and what a pity it is he cannot be imported for this purpose, or manufactured to order on the premises. But the Kala Pānee (black-water) interposes its baneful presence, and were one of these odorous worthies to spread his carpet in Shoe-lane or Belle-Sauvage-yard, the local inspector of nuisances would interfere, if, indeed, he had not been already forestalled by the local policeman.

(To be continued.)

THE *Engineer* observes that the South-Eastern Railway supremacy in unpunctuality provided its chairman a few days ago with the pleasure of about an hour's waiting for his destination near Dover.

* "The History of India, from the Earliest Ages," Vol. ii., p. 172.

† "The History of the Mahrattas," Vol. i., p. 424.

‡ "The Rambles and Recollections of a Bengal Officer," Vol. i., p. 345.

§ Ward has a curious illustration in point. The rescued man used to reproach and curse his deliverer whenever he met him. Nor was he much to blame for this, for he was an outcast, and, as Mr. Fairholt truly says ("Up the Nile," p. 294): "The undying character of popular superstition is more certain than the stability of a religious faith." "Nothing is so difficult to kill as an old superstition; the more unreasonable it is, the harder," says Mr. Fergusson ("Tree and Serpent Worship," p. 70), "it dies."

* Describing the performances in this line of a Mahomedan priest in the Gadūn country, near Peshawur, Mr. Hughes says ("Notes on Muhammadanism," p. 152) that "he has become such an adept in the performance of the *zarb*—a most exhausting devotional act—that he recites the first part of the zikr (prayer) with the exhalation of his breath, after the mid-day prayer, and the second part with the inhalation of his breath before the next time of prayer, thus sustaining his breath for the period of about three hours."

† "Travels in Kashmir, &c." By J. T. Vigne, pp. 307 8.

OUR DUAL BRAIN.

By RICHARD A. PROCTOR.

IN a recent lecture at the Royal Institution, Mr. Horsley offered evidence (which seems to me not very strong) against the theory of the duality of the mind. A person who, being already fairly well able to draw with either hand separately, attempts to draw simultaneously two different forms, however simple, with both hands, is tolerably sure to fail. Mr. Horsley appears to think that failure always results. When the effort is made, he says, "There is a very definite sensation in the mind of a conflict that is going on in the cortex of the brain. The idea of the circle alternates with that of the triangle, and the result of this confusion in the intellectual and sensorial portions of the brain is that both motor areas, though remembering, as it were, the determination of the experimenter to draw distinct figures, produce a like confused effect, namely, a circular triangle and a triangular circle."

Mr. Horsley adds that if the drawing is commenced immediately at the sound of a signal (as should always be done in such experiments), it will be found that the triangle predominates, while, on the other hand, if the two figures are not commenced simultaneously, the one last begun will appear most distinctly in the fused result, in fact, will very markedly predominate. He reasons upon this as follows :—"The idea of a triangle and circle having been presented to the intellect of the sensory centres, the voluntary effort to reproduce them is determined upon : now if we had a dual mind, and if each hemisphere was capable of acting *per se*, then we should have each intellectual area sending a message to its own motor area, with the result that the two figures would be *distinct and correct*, not fused."

To this experimental evidence and to its interpretation two distinct answers can be given. In the first place, it does not always happen that the attempt to draw two different objects simultaneously fails in the alleged manner. Setting on one side as probably exaggerated the story that Sir Edmund Landseer drew on one occasion a deer's head with one hand, while he was drawing a landscape with the other, I may cite from my own experience a case which entirely invalidates Mr. Horsley's evidence. My friend, Professor Edwin Morse, of Salem, Mass., could draw simultaneously, and that, too, before an audience, two different objects with either hand. Or he would draw an object with one hand, and at the same time write the names of the parts of the object with the other. With practice much skill may be acquired in this ambidextrous work.

Here is a simple experiment to show the effect of practice. Try for the first time to write a word of so many letters while you spell aloud, letter by letter, another word containing the same number of letters. At first you are almost sure (perhaps quite sure) to fail. But after a few trials what had seemed impossible becomes feasible, and presently it becomes quite easy.

Then, even if it were proved that we cannot do two different things at once (apart from cases where either or both is done automatically), this would no more prove that the brain is not dual than our inability to use the two eyes simultaneously to do different work would prove that we have not dual vision.

As a matter of fact we are able to prove very easily that vision is double, by alternately closing and opening either eye. We cannot make any corresponding experiment with the brain. We do not know even that, when we are trying to do simultaneously two different things the two different sides of the brain are called into action. We have positively no means of determining whether one side, or the other side, or both sides of the brain shall be used, or of knowing whether they are used. Even in those cases where marked alternations of character, accompanied or preceded by marked cerebral phenomena, show unmistakably that two different parts of the brain may alternate in the regulation of actions and even of character, the person thus dually minded and charactered is perfectly powerless as to the particular mental side of him which shall come uppermost (or act alone). He often does not even know that he is passing or has passed from one state to the other.

Since, however, we are absolutely certain that each eye does its work, while we are absolutely unable to make them work separately yet simultaneously—to make one eye work at long range, for example, and the other at short range, the argument used by Mr. Horsley in regard to the brain is altogether without force.

If any one could make his two eyes work separately, I should be the one to do it, for my left eye is permanently limited to work at short focal distances, while the right eye has the usual range. Yet, not only am I powerless to make my two eyes work separately and simultaneously, but I am very seldom conscious of the fact that the left eye is in reality presenting to the brain (so to speak) a very different picture from that which is presented by the right eye.

I remained unconscious of the difference between the focal lengths of my two eyes, marked though it is (insomuch, that for ordinary distances my left eye is almost blind), till I was about twenty ; at least I know it must have been more than twenty-six years ago that I detected the peculiarity. I was in church one Sunday evening, listening or not listening to a rather dreary sermon, in which a person whom I had reason for regarding little was enjoining duties which I had long learned to regard a great deal; and being naturally inattentive to him, I attended to other things. Now, there were in front of me two bright lights, and I noticed to the right of them two blurred lights, looking as large as the moon, where assuredly no lights were. I looked at another group of lights, three of them—and lo, to the right of them also, a group of three, similarly arranged, blurred lights. I closed my left eye, and could see only the bright lights ; I closed my right eye, and could see only the blurred lights. That was all my left eye could do in the way of showing those lights.

Thus, for the first time in my life, I learned that so far as distant objects were concerned I was almost blind of one eye. But I soon found that my left eye was by no means blind for near objects ; on the contrary, it was and is very keen for them. Yet I cannot make my eyes, different though they thus are, work separately, except in an imperfect sort of way, akin to the way in which, in Mr. Horsley's experiment, one hand makes a circular triangle while the other makes a triangular circle. I am well assured my vision is double, as all men are; nay, in my case vision is even of two kinds with the two eyes : yet I have precisely the sort of evidence respecting my two eyes which Mr. Horsley regards as evidence of unity.

Mr. Horsley cites a singular illustration of the duality of the mind, of which, however, he endeavours to dispose. The case is so remarkable, and, just now when all sorts of foolish superstitions are as rife as ever, so instructive, that I give its details here pretty nearly in full, as recorded by Prof. Ball, of Paris. He tells us that a

young man, a patient of his, one morning heard himself addressed by name, and yet could see no one. He replied to this invisible, and in reality imaginary, interlocutor; and a conversation followed, in the course of which the ghostly visitor informed him that he—the visitor—rejoiced in the name of Gabbage. After this, he was often favoured with visits from M. Gabbage. Unfortunately, the suggestions of M. Gabbage were generally open to objection. At one time M. Gabbage urged the patient to give an overdose of chlorodyne to a friend's child, at another his idea was that the young man would do well to jump out of a second-floor window.

Prof. Ball thought—naturally enough—that the young man needed watching. It was presently found that the patient was suffering from one-sided hallucination; that is to say, a strong but false impression, affecting one side only of the brain, appeared to come from some external cause, the healthy side rejecting the evidence as false. (Without doubt many superstitions, many false religious beliefs, and also many crimes, have been suggested in this way.)

Mr. Horsley finds nothing in this or similar cases to suggest the duality of the brain; but I take it that the evidence is precisely analogous to that which showed me not only the duality but the diversity of my own visual powers. Usually, of course, the two sides of the brain would give the same sort of evidence respecting external objects; just as—usually—the two eyes do: but in certain cases one side of the brain is defective or peculiar in some way or other, and so gives evidence which the better and sounder side rejects; just as in my case one eye gave evidence of large diffuse lights where I knew, from the sound evidence of my better eye, that small bright flames were burning. The analogy seems as perfect as it can be; and the necessary conclusion is that the brain's action, in ordinary cases, is as essentially dual as the action of the eyes in vision.

MYSTERIES AND MORALITIES.

By Edward Clodd.

VI.

WHATEVER afforded material for more vivid presentment of incidents connected with the birth of Christ was gladly utilised by the dramatisers, and in the meagreness of the canonical narratives, as well as in their silence, the Apocryphal Gospels, with their freer treatment of the mysteries of the miraculous conception and their record of the scandal to which it was assumed to give rise, were largely drawn upon.

This is especially noticeable in the Coventry series, in which eight plays bearing upon events preceding and surrounding the Nativity are based upon the Protevangelium or Gospel of James, the Gospel of Mary, and the History of Joseph the Carpenter. They treat of the barrenness of Anna, of Mary in the Temple, of her betrothment, of the salutation and conception, of Joseph's jealousy, of the visit to Elizabeth, and of the trial of Joseph and Mary.

Joseph's Jealousy, or Trouble about Mary, is the subject of a play in each series, the Chester excepted, in which the treatment of all incidents surrounding the birth of Christ is meagre. Joseph, when "very far advanced in years," had, as one of the house of David, been cited with his kinsmen to appear before the "Busshop" with "whyte yardys" in hand, that on whatsoever man's rod the "Holy Gost is syttynge," he should be betrothed to Mary. Joseph, who says:—

> I have be maydon evyr, and evyr more wele ben,
> I chaungyd not yet of alle my long lyff;
> And now to be maryed sum man wold wen (guess),
> It is a straunge thynge an old man to take a yonge wyff,

is appalled when, despite his striving to keep in the background, the "ded stok beryth floures," and he is told that he must take Mary to wife.

> Nay, nay, sere, lett bene,
> Xuld I now in age begynne to dote,
> If I here chyde she wolde clowte my cote,
> Blere myn ey, and pyke out a mote,
> And thus oftyn tymes it is sene.

But when told that God has ordained it he assents, and the betrothal follows, Joseph "hiring a lytyl praty hous" for Mary, where he leaves her to the care of five maidens while he travels to a "fere countré"—

> For in sothe we have non hous of oure owe,
> Therfore I xal gon ordeyn and thanne come yow fore."

The course of events is broken in the Coventry series by a pageant of the *Parliament of Heaven*, or, as Hone calls it, *A Council of the Trinity*, opening with a prologue by Contemplacio, who recites the fall of man and his need of redemption. Veritas, Justitia, and Misericordia alike supplicate the Divine mercy, and as the result of a council between the persons in the Trinity, the angel Gabriel is commanded to visit Mary and announce to her that "the son of the Godhead of here xal be bore." He salutes her with an anagrammatic pun if the reading "av ye" instead of "ar ye" is correct:

> Heyl, fful of grace, God is with the,
> Amonge alle women blyssyd art thu;
> Here this name Eva is turnyd Ave,
> That is to say withoutte sorwe av ye now.

A little after this the following stage direction occurs:

Here the Holy Gost discendit with iij. bemys to our Lady, the sone of the Godhed vest with iij. bemys to the Holy Gost, the fadyr Godly with iij. bemys to the sone, and so entre alle thre to her bosom, and Mary seyth:—

> *Maria.* Ah! now I ffele in my body be
> Parfyte God and parfyte man,
> Havyng alle schappe of chyldly carnalyté,
> Evyn al at onys thus God began.*

At the end of nine months Joseph returns, and finding Mary pregnant, rues the evil day when he was forced to wed, then meets her with reproaches for her faithlessness and with questions as to who has thus wronged him.†

He will not believe the strange answer which she gives him, and will steal away and leave her, but that an

* *Coventry Mysteries*, pp. 114, 115.

† *York Mysteries*, p. 105:—

> Whose is't, Marie?
> *Mar.* Sir, Goddis and youres.

Towneley Mysteries, p. 76:—

> Who owe this child thou gose with alle?
> *Maria.* Syr, ye and God of Heven.

Coventry Mysteries, p. 118:

> Ow! dame, what thinge menyth this?
> With childe thou gynnest ryth gret to gone.
> Sey me, Mary, this childys fadyr ho is!
> I pray the telle me, and that anon.
> *Maria.* The fadyr of hevyn and ye it is,
> Other fadyr hath he non;
> I dede nevyr forfete with man i-wys;
> Wherfore I pray you amende your mon,
> This childe is goddys and your.

angel appears and convinces him of her innocence and purity :—

She has consayued the Holy Gost,
And she shalle bere Godes son.*

The *rapprochement* between the two, when Mary forgives the repenting Joseph for doubting her, is represented with much tenderness :—

Saie, Mary wiffe, how fares thou ?
Mar. The bettir sir for yhou,
Why stand yhe thare ? Come nere.
Jos. My bakke fayne wolde I bowe
And aske fo[r]gifnesse nowe,
Wiste I thou wolde me here.
Mar. Forgiffnesse, sir ! late be ! for shame,
Slike (such) wordis suld all gud women lakke.†

The Towneley play corresponds to this too closely to need quotation ; but in the Coventry there is a pretty touch when, in response to Joseph's desire to kiss Mary's "swete fete," she says :—

Nay, lett be my fete, not tho (those) ye take,
My mouthe ye may kys i-wys,
And welcome onto me.

A distinctive pageant of this series, based on the *Trial of Joseph and Mary*,‡ is ushered in by an amusing address citing the persons named to appear before the Buschop :—

Bothe John Jurdon, and Geffrey Gyle,
Malkyn Mylkedoke, and fayr Mabyle,
Stevyn Sturdy, and Jak at the Style,
And Sawdyr Sadelere.

Thom Tynkere and Betrys Belle,
Peyrs Potter and Whatt at the Welle,
Symme Smalfeyth and Kate Kelle,
And Bertylmew the Bochere.
Kytt Cakelere and Colett Crane,
Gylle Fetyse and fayr Jane,
Powle Pewterere and Pernel Prane,
And Phelypp the good Flecchere.

Cok Crane and Davy Drydust,
Luce Lyere and Letyce Lytyltrust,
Miles the Myllere and Colle Crakecrust,
Bothe Bette the Bakere, and Robyn Rede.

And, adds the officer, showing that money was collected at the performances :—

And loke ye ryngewele in your purs,
Ffor ellys your cawse may spede the wurs,
Thow that ye slynge Goddys curs
Evyn at myn hede, ffast com away.

Bothe Boutyng the Browstere, and Sybyly Slynge,
Megge Merywedyr and Sabyn Sprynge,
Tyffany Twynkelere, ffayle ffor nothynge,
The courte xal be this day.§

* *York Mysteries*, pp. 110, 111 :—
Gabriel. The childe that sall be borne of her,
Itt is consayued of the haly gast,
Alle joie and blisse than sall be aftir,
And to al mankynde nowe althir mast (all that is best).
Jesus his name thou calle,
For slike happe sall hym fall
Als thou sall se in haste.
His pepull saff he sall
Of euyllis and angris all
That thei ar nowe enbraste.
Coventry Mysteries, p. 121 :—
Angelus. Sche is a ful clene may.
I telle the, God wyl of here be born,
And sche clene mayd as she was beforn,
To save mankynd that is forlorn,
Go chere hyre therfore, I say.

† *York Mysteries*, p. 111.

‡ *The Gospel of Pseudo-Matthew*, ch. xii (Cowper's ed.), pp. 46-49.

§ *Coventry Mysteries*, pp. 131, 132.

The charge of unchastity against Joseph, and more especially against Mary, is brought by two slanderers in language of unvarnished plainness, when the Bishop interrupts them and sends for the accused, who deny the charge, and are then severally bidden to submit their innocence or guilt to the test of ordeal by drinking the "botel of God's vengeannes,"* which would prove them guilty by producing "sum maculacion pleyn on the face."

Joseph drinks, walks round the altar seven times, and establishes his innocence ; then when Mary offers to do the like, *Primus detractor* says jeeringly :—

In ffeyth I suppose that this woman slepte
Withowtyn alle coverte, whylle that it dede snowe,
And a flake thereof into hyre mouthe crepte,
And thereof the chylde in hyre wombe doth growe.†

And *Secundus detractor*, following up the sneer, says :—

Than beware dame, for this is wel i-knowe
Whan it is born, yf that the sunne shyne,
It will turne to watyr ageyn, as I trowe,
Ffor snow onto water dothe evyr more reclyne."

Mary passes through the ordeal without "maculacion," and when the Bishop declares her "clene mayde, both modyr and wyff," *Primus detractor* charges him with having changed the draught, whereupon the slanderer is compelled to swallow what is left of it, and his sickness thereat is assuaged only through the Virgin's prayer.

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

HUNSTANTON AND THE RED CHALK.

OUR rambles have hitherto been confined to Wales and to the Midlands. It is now time to give the East coast a turn. The strata which form our little isle slant or "dip" to the east, the older beds passing under the newer in that direction. The result of this arrangement is that the oldest rocks form the surface of Wales, while the newest, latest-formed beds, occupy the shore-line round the mouth of the Thames.

In considering the rocks of any district we must always bear in mind the difference between its *solid* and its *superficial* geology. On an ordinary geological map only the former is shown, the stripes of colour indicating the various rocks which there form distinct beds or strata, such as can be followed in layers deep down into the earth. But these, so-called, solid rocks are frequently covered over and concealed by "superficial" beds of clay, sand, &c., often of great thickness, left by the melting of the glaciers or icebergs which invaded England during the last glacial period, perhaps some quarter of a million years ago. In the Eastern counties it is especially necessary to bear this distinction between the "solid" and "superficial" strata in mind, for nowhere else are the latter so well developed. An incipient geologist—say a farmer who is trying to learn something about the soil of his farm—may well be astonished when his geological map shows him the surface of Norfolk as a nearly uniform mass of white chalk ; while his experience in digging, well-sinking, &c., tells him of thick beds of clay and sand occupying the same area !

* Cf. Numbers, v. 10-31. The Bitter Water was one of several ordeals in use among the Hebrews, and bears an analogy to the poison ordeals of Africa and the East ; it was abandoned by R. Johanan ben Saccai about the time of the Christian era.

† *Coventry Mysteries*, p. 140. The story of a snow-child was popular in the Middle Ages, and a charming variant of it is given in "Naake's Slavonic Fairy Tales," pp. 9-16.

This discrepancy is now being remedied by the publication by the Government Geological Survey of *two* sets of geological maps for each district; the one showing the deep-seated rocks only, while the other—called the "Drift Maps"—show the exact nature of the rock, be it "solid" or "superficial," which *actually forms the surface* at any given point. With this preliminary explanation, we will pass on to the special subject of our paper—the rocks of that rising sea-side resort, Hunstanton.

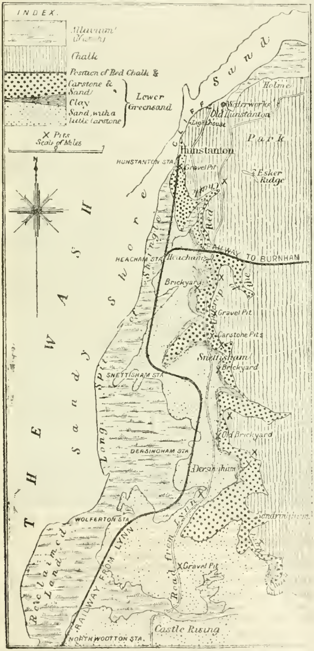


Fig. 1.—Geological Map (without Drift) of the Neighbourhood of Hunstanton (by W. Whitaker).

* The Red Chalk has been traced from Hunstanton southwards, to beyond Snettisham.

Hun'ston, as the native familiarly terms it, lies at the eastern corner of the Wash, facing the North Sea, and is, of course, in the county of Norfolk. It is well supplied with railway accommodation, in connection with the Great Eastern, Great Northern, and Midland Railway systems, and has grown very rapidly during the last few years. There are two villages—Old Hunstanton and Hunstanton St. Edmund's—divided by a line of chalk cliffs, ninety feet in height. Standing on these chalky heights, we can see Boston Stump (*i.e.*, the tower of Boston Church) across the Wash, to the west, while to the north-west extend the Lincolnshire Wolds, formed of the same white rock as that upon which we stand. It is clear that at some time or other the sea has breached the line of chalk hills, and then hollowed out the estuary, called the Wash, in the softer strata which lie below the chalk. To examine these older rocks, we must descend, and walk westward along the shore.

The dark, hard, gritty rocks, tinged yellow or red by a little iron, which crop out in the beach at Hunstanton, and form the base of the cliff, are sandstones belonging to the *Lower Greensand*, a subdivision of the Lower Cretaceous or Neocomian formation of geological textbooks. Our map (Fig. 1), which is a reduction of th Geological Survey map, recently prepared by that exc lent geologist, Mr. W. Whitaker, F.G.S., shows tl s *Lower Greensand*, extending southwards past Snettisham to Dersingham, Sandringham, &c. The pits in which the stone is worked round Snettisham should be carefully examined. The upper division of this sandstone has been hardened by an infiltration of water containing oxide of iron, which has acted as a cement to bind the grains of sand together. This hard, sandy rock is called "Carstone"—perhaps from "Quernstone"—since its gritty nature would make it suitable for the old hand-mills or querns once used to grind corn. It rises into picturesque, low, wooded hills between Hunstanton and Sandringham; the presence of a bed of clay just here, between the two divisions of the Greensand is indicated by a vigorous growth of oaks, while firs flourish on the sandy beds above and below. This clay is worked at Heacham brickyard. The "Carstone"—also called "Gingerbread-stone"—is used for building, while the lower, softer sands are shipped for glass-making. The Carstone at the base of Hunstanton cliff contains numerous small pebbles of quartz, &c.; of fossils there are but few, including some rolled *ammonites*. The total thickness of the *Lower Greensand* is not much more than 70 feet at Hunstanton, and if we could pierce through it, we should find it underlain by a dark, tenacious clay—the *Kimmeridge Clay*—which was indeed reached in a deep boring farther east, at Holkham, at a depth of 743 feet.

(To be continued.)

VARIATION OF A NEBULA.

THE following appeared in the *Times* of Saturday last:—

"SIR,—A circular, dated September 1, from Lord Crawford's observatory, Dun Echt, is as follows:—'Professor Kreuger telegraphs from Kiel at midnight, August 31: Variation in Andromeda nebula found by Dr. Hartwig (of Dorpat), starlike nucleus, please look for it.'

"From an examination of this nebula last night with a six-inch refractor, I can confirm his statement that there is a variation, and that of a most wonderful kind, as I had the great advantage of being able to compare the present aspect directly with a photograph I took last year (August 16).

"The centre of this nebula has hitherto always been noted as a bright condensation of the nebulous matter,

looking as one of the old astronomers said, like a candle in a horn lantern, and so it appears in the photograph. Now it appears as an intensely bright point, entirely different in character and very much more brilliant than before.

"About two minutes of arc from this new bright point there is a faint star many magnitudes less bright; this faint star shows on the photograph as bright, though not so large, as the old central condensation. I have no doubt we have here a case of real change taking place, and that astronomers will watch further developments with intense interest. A. A. COMMON, F.R.S."

"Ealing, Sept. 4.

"SIR,—The sudden appearance of a new star in the heavens is a rare event, which is so full of interest to many of your readers that it deserves to be carefully chronicled.

"On Aug. 31 Dr. Hartwig, of Dorpat, announced the discovery of a variation in the Andromeda nebula presenting the form of a starlike nucleus. Thanks to Lord Crawford's prompt dissemination of such astronomical news by means of the Dun Echt circulars, astronomers were generally informed of the discovery by Sept. 2.

"Last evening (Sept. 3), on examining the Andromeda nebula, the object was found to be conspicuously visible as a star of the eighth or ninth magnitude shining through the densest region of the nebula. It does not at all present the aspect of a nucleus to the nebula, and at present I have not been able to detect any change in the nebula itself. It seems evident, therefore, that the object is one of those enigmatical variable stars, such as were observed to suddenly blaze forth by Tycho Brahe in Cassiopeia, by Kepler in Serpentarius, and more recently in 1866 by the late Mr. Birmingham in Corona.

"Three sets of photometric comparisons with another star were secured. The small star adopted for a standard was one of the eighth magnitude in the Perseus cluster, and was selected because (1) it was about the same altitude as the new star, (2) observations for several years had shown that its light was not appreciably variable, and (3) because estimations of its magnitude are known, and moreover it is to be identified in the exquisite photograph of this cluster by the MM. Henry, at the Paris Observatory.

"Assuming this star as of 8·1 magnitude (it is probably rather higher), then the three sets of photometric measures, made on the principle of limiting apertures, give for the date 1885, September 3, 9 p.m. to 11 p.m.—'Nova Stella,' 8·8 magnitude, three observations; 8·7 magnitude, eight observations; 8·7 magnitude, four observations; mean 8·72 magnitude.

"If your readers will look towards the east between nine and ten o'clock in the evening, and rather high up, they will see a small misty spot of light—that is the Andromeda nebula—and on taking an opera glass they will not fail to detect in the middle of this misty spot a small star, which is the new one just started into visibility. To the spectroscope we must look to learn something of the nature of this remarkable outburst.

"EDWARD B. KNOBEL.

"Bocking, near Braintree, Essex, Sept. 4."

THE chairman and directors of the Great Western Railway proceeded through the Severn tunnel in a special train on Saturday fast, accompanied by a number of friends. The tunnel is to be formally opened by the Prince of Wales some months hence.

FIRST STAR LESSONS.

BY RICHARD A. PROCTOR.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

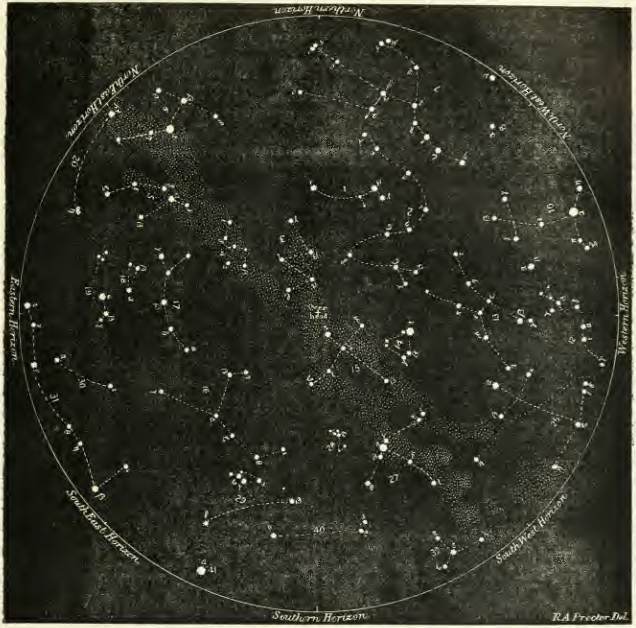
1. *Ursa Minor*, the *Little Bear* (*α*, the *Pole Star*).
2. *Draco*, the *Dragon* (*α*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*α*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*α*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*α*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*α*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*α*, *Vega*).
15. *Cygnus*, the *Swan* (*α*, *Arided*; *β*, *Albireo*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*α*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*α*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*α*, *Regulus*).
24. *Virgo*, the *Virgin* (*α*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*α*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*. the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*α*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*α*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*α*, *Alphard*).
36. *Crater*, the *Cup* (*α*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*α*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*α*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*α*, *Sirius*).
45. *Argo*, the *Ship*.

FINDING THE WAY AT SEA.

BY RICHARD A. PROCTOR.

(*Continued from page* 194.)

IT will be clear to the reader, by this time, that the great point in determining the longitude, is to have the true time of Greenwich or some other reference station, in order that by comparing this time with ship time, the longitude east or west of the reference station may be ascertained. Ship time can always be determined by a morning or afternoon observation of the sun, or by observing a known star when towards the east or west, at which time the diurnal motion raises or depresses it most rapidly. The latitude being known, the time of day (any given day) at which the sun or a star should have any particular altitude is known also, and, therefore, conversely, when the altitude of the sun or a star has been noted, the seaman has learned the time of day. But to find Greenwich time is another matter; and without Greenwich time, ship time teaches nothing as to the longitude. How is the voyager at sea or in desert places to know the exact time at Greenwich or some other fixed station? We have seen that chronometers are used for this purpose; and chronometers are now made so marvellously perfect in construction that they can be trusted to show true time within a few seconds, under ordinary conditions. But it must not be overlooked that in long voyages a chronometer, however



NIGHT SKY FOR SEPTEMBER (First Map of Pair),

Showing the heavens as they appear at the following hours:—

September 1 at $10\frac{1}{2}$ o'clock.	September 9 at $9\frac{3}{4}$ o'clock.	September 17 at $9\frac{1}{4}$ o'clock.
September 5 at 10 o'clock.	September 13 at $9\frac{1}{2}$ o'clock.	September 20 at 9 o'clock.

perfect its construction, is more liable to get wrong than at a fixed station. That it is continually tossed and shaken is something, but it is not the chief trial to which it is exposed. The great changes of temperature endured when a ship passes from the temperate latitudes across the torrid zone to the temperate zone again, try a chronometer far more severely than any ordinary form of motion. And then it is to be noted that a very insignificant time-error corresponds to a difference of longitude quite sufficient to occasion a serious error in the ship's estimated position. For this reason and for others, it is desirable to have some means of determining Greenwich time independently of chronometers.

This, in fact, is the famous problem for the solution of which such high rewards were offered and have been given.* It was to solve this problem that Whiston, the same who fondly imagined Newton was afraid of him,† suggested the use of bombs and mortars; for which

* For the invention of the chronometer Harrison (a Yorkshire carpenter and the son of a carpenter) received twenty thousand pounds. This sum had been offered for a marine chronometer which would stand the test of two voyages of assigned length. Harrison laboured fifty years before he succeeded in meeting the required conditions.

† Newton, for excellent reasons, had opposed Whiston's election to the Royal Society. Like most small men, Whiston was eager to secure a distinction which, unless spontaneously offered to him, could have conferred no real honour. Accordingly he was amusingly indignant with Newton for opposing him. "Newton perceived," he wrote, "that I could not do as his other darling friends did, that is,

Hogarth pilloried him in the celebrated madhouse scene of the "Rake's Progress." Of course, Whiston had perceived the essential feature of all methods intended for determining the longitude. Any signal which is *recognisable*, no matter by eye or ear, or in whatsoever way, at both stations, the reference station and the station whose longitude is required, must necessarily suffice to convey the time of one station to the other. The absurdity of Whiston's scheme lay in the implied supposition that any form of ordnance could propel rocket signals far enough to be seen or heard in mid-ocean. Manifestly the only signals available, when telegraphic communication is impossible, are signals in the celestial spaces; for these alone can be discerned simultaneously from widely distant parts of the earth. It has been to such signals, then, that men of science have turned for the required means of determining longitude.

Galileo was the first to point out that the satellites of Jupiter supply a series of signals which might serve to determine the longitude. When one of these bodies is eclipsed in Jupiter's shadow, or passes out of sight behind Jupiter's disc, or reappears from eclipse or occultation, the phenomenon is one which can be seen from a whole hemisphere of the earth's surface. It is as truly a signal as the appearance or disappearance of a light in ordinary night-signalling. If it can be calculated beforehand that one of these events will take place at any given hour of Greenwich time, then, from whatever spot the phenomenon is observed, it is known there that the Greenwich hour is that indicated. Theoretically this is a solution of the famous problem; and Galileo, the discoverer of Jupiter's four satellites, thought he had found the means of determining the longitude with great accuracy. Unfortunately these hopes have not been realised. At sea, indeed, except in the calmest weather, it is impossible to observe the phenomenon of Jupiter's satellites, simply because the telescope cannot be directed steadily upon the planet. But even on land Jupiter's satellites afford but imperfect means of guessing at the longitude. For, at present, their motions have not been thoroughly mastered by astronomers, and though the "Nautical Almanac" gives the estimated epochs for the various phenomena of the four satellites, yet, owing to the imperfection of these tables, these epochs are often found to be appreciably in error. There is yet another difficulty. The satellites are not mere points, but being in reality as large as or larger than our moon, they have discs of appreciable though small dimensions. Accordingly they do not vanish or reappear instantaneously, but gradually, the process lasting in reality several seconds (a longer or shorter time according to the particular satellite considered), and the estimated moment of the phenomenon thus comes to depend on the power of the telescope employed, on the skill or the visual powers of the observer, on the condition of the atmosphere, and so on. Accordingly, very little reliance could be placed on such observations as a means for determining the longitude with any considerable degree of exactness.

No other celestial phenomena present themselves except those depending on the moon's motions.* All the planets, as well as the sun and moon, traverse at various rates and in different paths the sphere of the fixed stars. But the moon alone moves with sufficient rapidity to act as a time-indicator for terrestrial voyagers. It is hardly necessary to explain why rapidity of motion is important; but the following illustration may be given for the purpose. The hour-hand of a clock does in reality indicate the minute as well as the hour; yet owing to the slowness of its motion we regard the hour-hand as an unsatisfactory time-indicator, and only consider it as showing what hour is in progress. So with the more slowly-moving celestial bodies. They would serve well enough, at least some among them would, to show the *day of the year*, if we could only imagine that such information were ever required from celestial bodies. But it would be hopeless to attempt to ascertain the true time with any degree of accuracy from their motions. Now the moon really moves with considerable rapidity among the stars.* She completes the circuit of the celestial sphere in 27⅓ days (a period less than the common lunation), so that in one day she traverses about thirteen degrees,—or her own diameter (which is rather more than half a degree) in about an hour. This, astronomi-

learn of him without contradicting him when I differed in opinion from him: he could not in his old age bear such contradiction, and so he was afraid of me the last thirteen years of his life."

* If but one star or a few would periodically (and quite regularly) "go out" for a few moments, the intervals between such vanishings being long enough to ensure that one would not be mistaken in point of time for the next or following one, then it would be possible to determine Greenwich or other reference time with great exactness. And here we cannot but recognise an argument against the singular theory that the stars were intended simply as lights to adorn our heavens and to be of use to mankind. The teleologists who have adopted this strange view can hardly show how the theory is consistent with the fact that quite readily the stars (or a few of them) might have been so contrived as to give man the means of travelling with much more security over the length and breadth of his domain than is at present possible. In this connection I venture to quote a passage in which Sir John Herschel has touched on the *usefulness* of the stars, in terms which were they not corrected by other and better known passages in his writings, might suggest that he had adopted the theory I have just mentioned:—"The stars," he said, in an address to the Astronomical Society, in 1827, "are landmarks of the universe; and amidst the endless and complicated fluctuations of our system, seem placed by its Creator as guides and records, not merely to elevate our minds by the contemplation of what is vast, but to teach us to direct our actions by reference to what is immutable in His works. It is indeed hardly possible to over-appreciate their value in this point of view. Every well-determined star, from the moment its place is registered, becomes to the astronomer, the geographer, the navigator, the surveyor, a point of departure which can never deceive or fail him,—the same for ever and in all places, of a delicacy so extreme as to be a test for every instrument yet invented by man, yet equally adapted for the most ordinary purposes; as available for regulating a town clock as for conducting a navy to the Indies; as effective for mapping down the intricacies of a petty barony as for adjusting the boundaries of transatlantic empires. When once its place has been thoroughly ascertained, and carefully recorded, the brazen circle with which the useful work was done may moulder, the marble pillar may totter on its base, and the astronomer himself survive only in the gratitude of posterity; but the record remains, and transfuses all its own exactness into every determination which takes it for a groundwork, giving to inferior instruments, nay, even to temporary contrivances, and to the observations of a few weeks or days, all the precision attained originally at the cost of so much time, labour, and expense." It is only necessary as a corrective to the erroneous ideas which might otherwise be suggested by this somewhat high-flown passage, to quote the following remarks from the work which represented Sir John Herschel's more matured views, his well-known "Outlines of Astronomy." "For what purpose are we to suppose such magnificent bodies scattered through the abyss of space? Surely not to illuminate our nights, which an additional moon of the thousandth part of the size of our own world would do much better; nor to sparkle as a pageant void of meaning and reality, and bewilder us among vain conjectures. Useful, it is true, they are to man as points of exact and permanent reference, but he must have studied astronomy to little purpose, who can suppose man to be the only object of his Creator's care; or who does not see in the vast and wonderful apparatus around us, provision for other races of animated beings."

* It was this, doubtless, which led to the distinction recognised in the book of Job, where the moon is described as "*walking* in brightness."

cally speaking, is very rapid motion; and as it can be detected in a few seconds by telescopic comparison of the moon's place with that of some fixed star, it serves to show the time within a few seconds, which is precisely what is required by the seaman. Theoretically, all he has to do is to take the moon's apparent distance from a known star, and also her height and the star's height above the horizon. Thence he can calculate what would be the moon's distance from the star at the moment of observation, if the observer were at the earth's centre. But the Nautical Almanac informs him of the precise instant of Greenwich time corresponding to this calculated distance. So he has, what he requires, the true Greenwich time.

It will be manifest that all methods of finding the way at sea, except the rough processes depending on the log and compass, require that the celestial bodies, or some of them, should be seen. Hence it is that cloudy weather for any considerable length of time, occasions danger and sometimes leads to shipwreck and loss of life. Of course, the captain of a ship proceeds with extreme caution when the weather has long been cloudy, especially if according to his reckoning he is drawing near shore. Then the lead comes into play, that by soundings, if possible, the approach to shore may be indicated. Then also by day and night a careful watch is kept for the signs of land. But it sometimes happens that despite all such precautions a ship is lost; for there are conditions of weather which, occurring when a ship is nearing shore, render the most careful look-out futile. These conditions may be regarded as included among ordinary sea-risks, by which term are understood all such dangers as would leave a captain blameless if shipwreck occurred. It would be well if no ships were ever lost save from ordinary sea-risks; but unfortunately ships are sometimes cast ashore for want of care; either in maintaining due watch as the shore is approached, or taking advantage of opportunities, which may be few and far between, for observing sun, or moon, or stars, as the voyage proceeds. It may safely be said that the greater number of avoidable shipwrecks have been occasioned by the neglect of due care in finding the way at sea.

THE PARADISE FISH AND ITS NEST.

By C. F. Holder.

THOSE who are familiar with the difficulties that attend the transportation of foreign and tropical fish to this latitude will appreciate the fact that two paradise fishes (*Macropodus viridi-auratus*) have been safely brought from India, and are flourishing in an aquarium in the museum-room at Fulton Market. They seem perfectly acclimated, and it is hoped that they may be introduced into American waters in the latitude from which they were taken. That they would prove an acquisition, no one could doubt after a contemplation of their movements, and I am indebted to Prof. H. J. Rice for opportunities for examining them.

In its native country the paradise fish has a somewhat unenviable reputation, being pugnacious in the extreme; so much so, indeed, that it is used by the Siamese very much as the Malays use the game-cock.

The native name of the fish is plakat, and in every town they can be found kept in glass jars and domesticated to a remarkable degree, the possibilities of which are well shown in the actions of the Fulton Market specimens. The Siamese use the fish principally in fighting, the method being to place them in glass vessels near each other, when they soon become enraged. When fully aroused they are placed together, and the result is attended with all the excitement of the prize-ring, the natives betting large sums on the contest.

The following account of the appearance when excited of a variety of this fish reared for fighting purposes is given by Dr. Cantor:—

"When the fish is in a state of quiet, with the fins at rest, the dull colours present nothing remarkable. But if two are brought within sight of each other, or if one sees its own image in a looking-glass, the little creature becomes suddenly excited, the raised fins and the whole body shine with metallic colours of dazzling beauty, while the projected gill membrane, waving like a black frill round the throat, adds something grotesque to the general appearance. In this state of irritation it makes repeated darts at its real or reflected antagonist. But the fish, when out of each other's sight, instantly become quiet. This description of their actions was drawn up in 1840, at Singapore, by a gentleman who had received a present of several from the King of Siam. They were kept singly in glasses of water, fed with the larvæ of mosquitoes, and had thus lived many months. The Siamese are infatuated with combats of these fishes, and sometimes their liberty, and that of their families, is staked on the issue. The licence to exhibit fish fights is farmed, and yields a considerable revenue to the crown."

After such a description one would naturally expect to see a fish of a somewhat ferocious aspect; but, on the contrary, the Fulton Market specimens seem to be thoroughly domesticated, and on the best terms of good fellowship. This is probably owing to the fact that the pair are male and female.

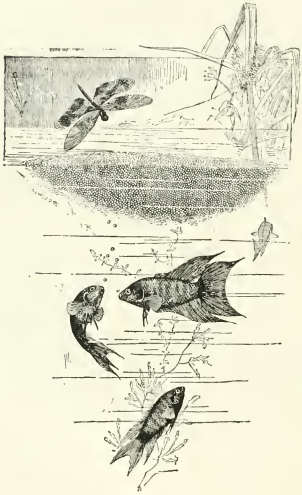
They are sombre little creatures, calling to mind our pomotis in general shape, though in an instant they seem to transform themselves into an entirely different creature, a paradise fish in the true sense of the word. They are about 3 to 3½ in. in length, of a sober greenish-brown hue, with darker and small spots. When moving along quietly, they look very much like some of the peculiar forms of gold-fishes with trilobed tails, and would, perhaps, attract but little attention. If anything occurs to excite them, the change is instantaneous; the dorsal and caudal fins develope into enormous fans, and appear to vibrate with excitement. Each ray springs into an erect position, booming out the living sail, as it were, so that the fish appears to have almost doubled its size.

The secret of this transformation is seen by an examination of the fins. The dorsal and anal fins are alike, and commence in the same relative position, as shown in the accompanying illustration. They extend back for half an inch, retaining the same height, then suddenly enlarge, the rays reaching gracefully away, like plumes, so that they extend beyond the end of the vertebral column an inch or more. Here they seem to join the tail, which is almost twice the width of the fish, also ending in points.

With such an array, the movements of the fish could not be other than graceful. The waving, plume-like appendages were constantly in motion, forming graceful curves as the fish darted about, expanding when they remained stationary, and closing when swimming, affording a continual change of picturesque attitudes to the observers. Every motion of my hand or finger against the glass was quickly noticed, and they would instantly arise to the surface. Professor Rice informed me that they readily fed from his hand, a common trick of the

common sunfish. I recently possessed one of the latter that not only took flies from my hand, but would thrust its head out of water as far as the pectoral fins to take them.

So active are the paradise fishes, alive to every movement, that they present a strange contrast to the clumsy golden carp in the same tank. All the fins become erect in a manner that reminds one of the sudden spreading of the peacock's tail. There was also another curious movement that seemed to quite change the expression of the fish. As soon as they met they remained stationary, face to face, for a moment, each expanding or opening the gill covers, so that they appeared puffed out at quite an angle, exposing the red gills quite plainly from behind. This salute, or whatever it was, was performed four or



The Paradise Fish.

five times in as many minutes; in fact, every time they met in their movements up and down the tank. At times they would face each other, and, while retaining the same relative position, move round and round each other, their plume-like fins waving behind and presenting an attractive appearance.

The nest-building, which Professor Rice has been fortunate in observing, is carried on, as is the rule with other nest-building fishes, entirely by the male. Approaching the surface of the water, he sucks in a mouthful of air with a clicking sound, and descends six or eight inches below, then facing the surface he releases the air in small mucous-covered bubbles, that rise to the surface, joining together, adhering, however, very lightly at first. Another mouthful of air is taken and other bubbles added, until finally a platform of these floats rests upon the water, forming a raft, perhaps four or five inches in diameter. Others are then added that tend to lift the upper layer, so that it has a convex surface, or resembles a watch crystal. Bubbles are added until the nest is three or four inches deep, according to circumstances, and undoubtedly it is often larger. In Professor Rice's aquarium the nests were, perhaps, not as complete as they would have been in open water, and the mass of bubbles was comparatively small and easily blown apart by the breath. Age would, however, soon render the nest more compact; fungoid growths would seal the bubbles together, and in a short time the nest would be of a consistence to resist the strongest breeze. When the fish had completed his labours, he began to chase the female about, endeavouring to drive her in the direction of the nest, but in this he failed, she probably not being ready for the maternal duties.

In their native streams the female deposits her eggs under or in the mass of bubbles; there they are held until hatched, the young at first feeding from the mucous spittle, if so it may be termed, of which the nest is made. Professor Rice suggested to me that it was possible that there was more architectural ability shown in the structure of the nest than would appear from a casual glance, and that the eggs were not deposited at random in the mass, but found their way into the upper portion, that he thought might be a pseudo air-chamber formed by the extreme upper layers of bubbles and the layer resting upon the water. Whether this is the case will be determined when the eggs are deposited. It would appear more likely that they are deposited at random, and cling wherever they are caught by the bubbles.

A large number of marine fishes deposit their eggs either upon the surface or in position where they ultimately rise, and those of the angler are enclosed in a long gelatinous ribbon; but in the paradise fish we find a decided improvement, as if the fish had learned by experience that if its eggs became separated they would fare badly; hence the bubble-nest was extemporised to keep them together at the surface, where, perhaps, in the disguise of a mass of froth, they float about, safe from all predatory enemies.—*Scientific American.*

JUST ONE BOOK.

To the Editor of KNOWLEDGE.

SIR,—Will you spare a few lines in your widely-read paper to plead with the tourist readers in behalf of the stay-at-homes who have no books to read. At this season many interesting and amusing works are purchased at railway book-stalls, and thrown aside after having served for the recreation of a few hours' journey. These would be greatly valued by the sick, the poor, the old and infirm, who have few pleasures but reading. The Kyrle Society, 14, Nottingham-place, W., will take charge (through their Hon. Sec. of the Literature Distribution Branch) of any books sent and will see that they reach an appropriate haven either in hospitals, infirmaries, workhouses, boys' or men's clubs, or wherever they may be wanted. The applications far exceed the supply already. Magazines, whether of general interest or of a technical character, such as the medical or engineering, &c., periodicals are specially acceptable. I will not trespass on your space; those that enjoy reading will, I am sure, like to help us, and will all (if they can do no more) send us just one book. Further particulars will be sent gladly to any address by

EMMA S. BUSK,
Hon. Sec. Literature Distribution Branch Kyrle Society.
14, Nottingham-place.

Gossip.

By Richard A. Proctor.

With regard to last week's announcement as to the change of Knowledge to a monthly magazine after the last number in September, it has since been found necessary to extend the weekly issue until October 16.

The discovery of a new star in the great Andromeda nebula must be regarded as decidedly a point for us (Mr. Herbert Spencer, Cleveland Abbe, myself, and—well, I know no others)—who have maintained for several years past, that none of the nebulæ are external galaxies. For certainly, if there was one exception which even we might have been disposed to make, the nebula in Andromeda, with its great size, its proved stellar constitution, and its position (not obviously associating it with the stars) would have been selected.

The *Times*, which somehow seems unfortunate in its staff writers on scientific matters, has some singularly inexact remarks about the nebula, and the recent change. Thus, it says, "Sir William Herschel inferred, from the fact that some nebulæ could not be resolved into stars even with his powerful instruments, that there were many composed of the primeval cosmic matter of the universe." He did so; but this remark, applied to the Andromeda nebula, which has been shown to be stellar in constitution, is rather worse than out of place: it sugges's entirely incorrect ideas.

Again, the writer in the *Times* remarks, "The varied forms assumed by nebulæ induced Laplace to trace the origin of the whole system to nebulous matter, and this despite the fact that no decided change had been noted in any particular nebula. His idea of the change he illustrated by referring to the trees in a forest, which show no change during a single glance, but show plants in different stages related to each other in order of time, to trace out which in a single instance the life of man or the duration of a solar system would be required." This is an altogether incorrect account of Laplace's views. He was led to his theory of the origin of the solar system, which the *Times* writer presumably means when he vaguely speaks of "the whole system," not by observing the varied forms assumed by nebulæ, but by observing the nature of the movements within the solar system. It was after he had already suggested and described his hypothesis, which was never regarded by him as a theory, that he recognised evidence in its favour in the varied forms of nebulæ. Sir W. Herschel long preceded Laplace in suggesting that, though we might never hope to follow the processes of change by which a nebula passes from one form to another, we might yet recognise them by comparing nebula with nebula as in a garden we compare trees of different age.

Finally the writer in the *Times* makes the following remarks:—"In Laplace's theory the sun was surrounded by an immense nebulous envelope or atmosphere rotating with it, which extended beyond the farthest member of our system. From this envelope several rings of nebulous matter were thrown off, and these rings finally broke up into globular masses, thus forming the planets. It is considered by Captain Abney that the theory of evolution of suns and systems from nebulous matter has received strong support from spectroscopic observations. Doubtless the discovery of Herr Hartwig (*sic*) will prove a stimulus to observers possessing large instruments, and lead to a careful watch for any similar changes which will aid in the solution, or rather the acceptation, of the nebular theory." This account of Laplace's hypothesis is full of inaccuracies. The sun was not according to that hypothesis surrounded by, but formed out of, the immense nebulous mass extending beyond the orbit of the farthest existing planet; again, if nebulous rings broke up into globular masses, forming the planets, the planets would travel in rings, which they persistently decline to do—only the asteroids adopting that comparatively undignified course. What Captain Abney has found in support of Laplace's nebular hypothesis is not regarded by astronomers as amounting to very much: the weight of spectroscopic evidence points to a theory in which the process imagined by Laplace plays a very subordinate part.

Lastly the appearance of a new star, or sun, suddenly, in the midst of a mass of already stellar matter, will most assuredly not lead to the "acceptation" of Laplace's hypothesis of the gradual formation of sun and planets out of gaseous matter. Laplace himself, who probably knew something about his own hypothesis, explained clearly, or rather urged strongly, that we must not expect to have any evidence of the actual progress even of such changes as he imagined to have taken place during the embryonic condition of our solar system,—and these changes, even if the occurrence of any of them could have been infinitely hurried, so as to come within human cognisance as observed events, would have been quite unlike what has been observed in the Andromeda nebula. The spectrum of Laplace's nebulous embryon of the solar system would have been assuredly one indicating gaseity and great tenuity—assuming always that that nebulous embryon ever existed: the spectrum of the Andromeda nebula indicates the presence of incandescent solid, liquid, or vaporous masses, shining through strongly absorptive vapours.

Readers of Knowledge will share our regret that Mr. Alexander is to leave us, and at the occasion.

With regard to his remarks on Darwin's use of the singular number, in the case of the word "progenitor," it would certainly be to misunderstand the theory of natural selection utterly, were we to image that he believed each species descended from a single pair. The whole theory is inconsistent with that idea. It may be remembered that Huxley in reviewing Darwin's "Origin of Species" cited the case of the Ancon sheep as apparently indicating the possibility of exceptions to the rule of natural selection. For in that case a new species seemed to come into existence *per saltum*,—in using which word I intend no reference to the alleged convenience (Huxley is the authority) of the great length of the Ancon sheep's body for leaping over hedges and ditches. So also Mivart points to sudden variations as opposed to the principle of development by natural selection.

The fact is that the idea of races, species, nations, &c., being derived from a single pair, belongs to a very undeveloped stage of inquiry. So soon as men begin to recognise the complicated relations involved in such matters, and that such relations must have existed from

time immemorial, they see the absurdity of supposing that all lions descended from two ancestral lions, all whales from two ancestral whales, all Greeks from two ancestral Greeks, and so forth. It would in reality be not one whit more absurd for an historian acquainted with what is now known about nations, to begin a history of England by describing the English nation as descended from an ancestral English man and woman, Anglus and Angelina, who settled in the middle of the island, in the fourth generation from Noah and his wife, as it would be for a naturalist, acquainted with modern discoveries and researches in biology, to picture the human race as descended from two ancestral anthropoid apes. I cannot but think that Darwin would have been a little amused had he guessed that his use of the word "progenitor" would have been so singularly misinterpreted. One might almost as justly assert that Pope supposed a solitary male savage to run continually about the forests of the earth because he wrote, "When wild in woods the noble savage ran," and not "many noble savages, male and female, used frequently to run,—or walk when tired of running."

The *Daily News* in an amusing article about publishing-piracy in America, calls attention to Tennyson's quaint suggestion that those publishers who have made money by selling his books in America, without making him one penny the richer, should subscribe largely to the Gordon Fund. The idea is excellent; but I imagine the Gordon Fund will not gain more than the Poet Laureate has gained himself, from the proceeds of the American sales of his books. It would be such a surrender of principle, to admit in that way that Tennyson ought long since to have received money from the other side. Had he privately applied for a good round sum for himself, he would have had a much better chance of getting it from American generosity. For in the present state of the law every such payment, be it remembered, is a gift.

In passing let me remark that I tried,—indeed I did, —when penning the above paragraph to write Lord Tennyson (the first "T" shows clear traces of the attempt). But the Lordship and the poet fit as ill as Burns's gaugership with his poetry. By way of a jest Thackeray could write "Mr. Secretary Addison"; but only so. Thank goodness all our best poets except this one are left without any such attached tin-kettle—or call it a "tinkling cymbal." Imagine having to write King Shakespeare, or Duke Chaucer, or Prince Milton!

To return to American publishers. I have had probably as varied experiences with the American publishing trade as most men. There has certainly been good as well as bad in their relations with me. Messrs. Appleton were the first to take to a work of mine—that is, to take it. They published an American edition of my "Other Worlds than Ours," from which I received no direct profit. But I gained largely—though I can scarcely thank *them* for that—by becoming better known than I had been in America. I cannot but attribute to this a large part of the success I obtained in America in 1873-4—a time so bad that Bellew and Wilkie Collins both failed there, returning before the end of 1873 to this country. Messrs. Appleton directly helped me also—and for this I may legitimately thank them—to that success. Professor Youmans in particular, who has done more than any living man to improve the relations between literary men and publishers in the two countries, and who may be regarded as representing Messrs. Appleton in a literary way, may be said to have *made* my reception favourable.

Americans, by the way, have an unpleasing way—some of them—of calling the profits an English lecturer may make in America, "money taken by Englishmen out of America." I think an English author whose works have been pirated over the water may fairly take a very different view of the matter. A traveller who should meet in a social sort of way a gentlemanly pirate who held a quantity of what had been and should still be that traveller's property, would hardly think he was taking away other folks' money if he received in part payment a sum collected by the comrades of the pleasant buccaneer.

In other ways, Messrs. Appleton made me the *amende honorable*. They engaged my services, on very handsome terms, in writing the Astronomy and part of the Meteorology of the "American Cyclopædia." This, though it might seem but a business bargain, was in reality kindly and generous. It exposed them to fierce abuse from certain American astronomers who could not write, and certain American writers who knew little astronomy. These—both astronomers and writers—thought themfelves wronged when an Englishman was engaged on what they regarded as their work. One of them revenged himself within a year by reviewing a book of mine in such blind wrath that he abused in company with it a book which was still in MS. in my desk. He was severely but deservedly rebuked in the leading New York papers. Another sent Messrs. Appleton a pamphlet pointing out that my account of the precession of the equinoxes was not new though perhaps not untrue, and presently distinguished himself by publishing a work on astronomy in which an explanation which was not true, though decidedly it was new, made its appearance. Whether I, or Messrs. Appleton, have been forgiven yet I do not know. Probably not.

The *Daily News* mentions that English publishers have not been free from blame, quoting one remarkable case where one of them not only stole an American's work but dedicated it to a person whom that American by no means admired. In like sort Messrs. Lippincott "took over" Chambers' "Cyclopædia," and modified it, without explaining what they were doing, by abusing English kings and queens and English rulers and statesmen. My own work has been curiously modified in the same non-explanatory way over the water. Thus, when I received the stereotyped proofs of my article on the Moon for the "American Cyclopædia," I found, too late for any alteration, that a most remarkable theory by a Mr. Boyle (I have always remembered the name because I felt like boyling over myself) respecting the existence of pools of water on the moon, had been added to it. There was eventually quite a disturbance over these pools, which were cast up at me by the astronomers and writers above mentioned. It was, indeed, when I explained where they came from, that I learned through Messrs. Appleton (who always thought my rejection of those pools very unfair) how indignant American astronomers and writers had been. I still stand by my opposition to the lunar pools; but I am bound to admit that as I had not, in returning the stereotyped proof, insisted on their being remorselessly cut out, Messrs. Appleton were justified in thinking I had accepted them. I had an idea, I

think, that their discoverer's name would be mentioned. It was an unfortunate business altogether. The moral, however, should be that no man's work should be tampered with without full explanation,—also this, that no matter should be stereotyped till it has been sanctioned by the author, or responsible reviser.

With Messrs. Scribner and with Messrs. Putnam's Sons, I have always had very pleasant relations. Messrs. Scribner did once urge my publishers in England to persuade me not to work so hard, as my books "crowded" each other. But there was nothing very unpleasant in that. So far as I know no pirated editions of my work have been published by either firm.

Messrs. Harper when recently publishing a cheap edition of one of my works, sent me a cheque, which I must perforce regard as a gift, in the actual state of the law,—or rather in the absence of any law of copyright between England and America. The amount probably corresponded to about the loss which I incurred during the first month after the cheap edition was published. But all the same, I considered myself fortunate that the work had not been taken over by one of the new race of cheap pirates, who not only pay nothing, but sell badly-printed copies of a man's books on bad paper, and badly sewn,—thus adding insult to injury.

Messrs. Funk & Wagnall also stand between the unfortunate English author and the horde of pirates just referred to. They sell cheap editions, and pay the author what the sale justifies,—every cent being in reality a gift, as the law stands.

Nathaniel Hawthorne abused the English publishers as thieves and pirates, and "hypocrites at that,"—because he maintained that the fault has been as great on this side of the water as on the other. In answer to this it is only necessary to point out that England has international copyright with every nation willing to make an honest treaty of the kind.

It is curious by the way how Hawthorne's coarseness came to the surface in a matter which moved him personally. Many Americans regard him as the most delicate of all writers; and he himself was too delicately-minded to bear association with his family circle. Yet this delicately-minded person could find no pleasanter way of mentioning that English ladies sometimes incline to *embonpoint* towards middle life, than by comparing them to cows.

In like manner Mr. Wilkie, editor of the *Chicago Times,* was shocked by the ill manners of Englishmen in wearing their hats when ladies are present in hotel corridors (for which there is this very excellent reason that the outer air is not excluded in England as in America from the interiors of hotels); yet this exceedingly delicate American, who considers that respect for the other sex should rise to reverence, or even as Mr. H. James, junr., suggests in "The American" should become a sort of religion, did not hesitate to hold a sick child in a sailing yacht in such a way that a lady's dress should be ruined (even having the gallant achievement carefully illustrated) for no better reason than that in his opinion the lady should have relieved the child's mother (who was also sick) of the care of it. In my copy of Mr. Wilkie's work, this incident is marked by a cross-reference in pencil to the passage praising the average American's intense reverence for women. Not that I would ridicule any attempt to inculcate due respect and attention, which some in this country as in America fail at times to show. But exaggerated nonsense about religious reverence, associated with gross (one may say brutal) coarseness,—*c'est par trop fort.* To show how far some will go in this direction the reviews of Miss Cleveland's works should be seen. That her writing is silly and stilted may be admitted; but she is called names, by these reverential persons, which an English costermonger might hesitate to use. Of course it is only in Republican papers that the sister of the Democratic President is so treated; but this is a point of no importance to the argument.

The *Amateur Photographer* records the artistic adventures of Captain J. Peters, of the Citadel, Quebec, who is said to be actually the first who has ever taken photographs of a battle while under fire. During the rebellion in the North-West he took about sixty pictures, a dozen of these being taken during the battles of "Batoche" and "Fish Creek," and *all under fire,* one of them during a volley from the rebels' pits *about* 150 *yards distant.* The exploits of the gallant captain speak well for his pluck and presence of mind, for the numerous operations required to make a negative, even on one of the improved dry plates, demand a steady hand and an amount of attention difficult to give when under fire. As to the quality of the pictures so produced, we trust we shall be enabled to judge for ourselves, and join the *Amateur Photographer* in the hope that Captain Peters will send copies of his unique "battle-pieces" for reproduction.

Reviews.

SOME BOOKS ON OUR TABLE.

A Practical Arithmetic. By John Jackson. (London: Blackie & Son. 1885.)—"It may be claimed for this arithmetic," says Mr. Jackson in his introduction, "that it is an entirely unique production, and that in no treatise extant are the same excellencies attempted, or even suggested . . . " Without absolutely endorsing this somewhat hyperbolical description given by the author of his own work, we may say that it is really what it professes to be, eminently practical; and that in his employment of the algebraical device of adding a negative quantity instead of subtracting a positive one; and in his conversion of the ordinary rule of three "stating" into a fraction, he has employed a more scientific form of treatment than that which these branches of his subject generally receive. He is very apt in contractions generally, and more than one of his devices for simplifying calculation will be found useful. The numerous worked-out illustrations of the text add materially to its usefulness. He has produced a school-book of real value.

Burnham Beeches. By Francis George Heath. Holiday Edition. (London: Wm. Rider & Son. 1885.)—This is the sixth edition of Mr. Heath's well-known description of one of the most delightful pieces of all our English sylvan scenery. It will not be forgotten how, through the exertions of the author of the work before us, the much-maligned Corporation of the City

of London were prompted patriotically to rescue this glorious tract of primitive land from the hands of the speculator and jerry builder, and dedicate it to the public for ever. Incidentally Mr. Heath gives a short account of Stoke Pogis, rendered classical by Gray's "Elegy in a Country Churchyard." Four engravings from photographs of the "Beeches," four from the same number of Mr. Burket Foster's charming vignettes, and a map at once adorn and illustrate the volume.

High-Class Cookery Recipes. By Mrs. Charles Clarke. (London: W. H. Allen & Co. 1885.)—Mrs. Clarke, who is the Lady Superintendent of the National Training School of Cookery at South Kensington, has produced a work of unquestionable value in the volume before us. Nothing can be at once more methodical and lucid than her recipes, in which quantities, materials, and times are given in a manner which renders a mistake practically impossible. It must, however, be added that she fully justifies her selection of a title, inasmuch as her recipes are rigidly confined to high-class cookery; and that the struggling housewife with £200 a year *pour tout potage* will find Mrs. Clarke's dainty and delicious dishes but ill-adapted indeed to her pecuniary resources. All, though, capable of appreciating culinary artistic triumphs (and of paying for them), should lose no time in possessing themselves of so sure and certain a guide as is here offered to them by our authoress.

Land Surveying on the Meridian and Perpendicular System. By Wm. Penman, C.E. (London: E. & F. N. Spon. 1885.)—The practice of land-surveying in England is ordinarily conducted upon one of two extreme principles. On the one hand it is performed (and this in a large majority of cases) by the chain alone, sometimes with the aid of the old-fashioned "cross-staff;" on the other, with all the elaboration of angular measurement on the geodetical or trigonometrical system. The first method is easy but moderately inaccurate; the latter difficult, tedious, and operose, but possessing the undeniable merit of being rigidly correct. The Ordnance Survey of the United Kingdom supplies an example of its application; while stewards and surveyors in country districts still, as a class, adhere to the more primitive system. The object of Mr. Penman in the work now before us is to exemplify and recommend for adoption a trigonometrical system of surveying, which shall secure all the accuracy needed for practical purposes, without entailing the great amount of labour involved in the ordinary geodetical method. He gives minute instructions for the adjustments and use of the theodolite and chain, teaches the student how to measure his base line and obtain his primary and secondary triangles from it; how to determine its deviation from the astronomical meridian of the place; how to connect distant points, &c.; and finally, how to plot the results of his observations, and to make a map from them. All this is illustrated by the details of an actual survey, the map embodying the conclusions of which is appended to the volume. All the calculations are given at length, while engravings are scattered throughout the text. This is a book to be commended to the study of all who may have occasion to survey any moderately large area of land, and who may be content to take a (very) little more pains than usual to secure an accurate delineation of it.

London, Old and New; a Sanitary Contrast. By Ernest Hart. (London: Allman & Son.)—In this pamphlet Mr. Hart gives a sketch of London from the date of the Roman occupation of Britain down to the present day; showing how the sanitary regulations and appliances of the Romans fell into desuetude after they finally quitted Britain, and how mediævally filth became rampant, and, in fact, to a great extent, synonymous with religion. He then adverts to the improvement in sanitary arrangements which was initiated about the time of Henry II., and traces this down to the present day. The effect of progress in hygiene may perhaps be illustrated by the simple statement, that while from 1620 to 1643 the annual rate of mortality in London was 70 per 1,000, during the past four years it has declined to 20·9 out of every 1,000 inhabitants.

Sensations of Tone. By Hermann L. F. Helmholtz, M.D., &c. Second English edition, translated by Alexander J. Ellis, B.A., F.R.S., &c. (London: Longmans, Green & Co. 1885.)—If we were asked to describe this wonderful work of Professor Helmholtz in the most succinct manner possible, we might well do so by speaking of it as the *Principia* of Modern Acoustics. For assuredly to the Great Physicist of Berlin are we indebted for the most complete and exhaustive account in existence of that branch of science towards the elucidation and establishment of which he has himself so largely contributed. Beginning with the composition of vibrations, the wave theory of sound is expounded both experimentally and mathematically, the distinction between mere noise and music pointed out, and a lucid explanation given of what constitutes the quality of tone, and enables everyone at once to distinguish between the sound of any given note as rendered by the human voice, the pianoforte, organ, violin, or flute, &c. The manner in which what are called "Partial Tones" are separated from a fundamental note sounded by any of these instruments forms the subject of a succeeding chapter, and introduces us to our author's extremely ingenious "Resonators," by the aid of which these partial tones may be picked out and, as it were, isolated. Subsequently the qualities of tones are discussed, and the why and wherefore of harmony and discord made clear. Incidentally, the anatomy and physiology of the ear are treated on, and a new theory of the functions of certain of its anatomical elements discussed; while, in conclusion, the æsthetical aspects of the subject come under review, and an attempt is made to show why one sort of music is pleasurable and another painful to the ears. So far, we have dealt only with Professor Helmholtz's share in the volume before us; but we should convey but an inadequate idea indeed of its value and importance if we stopped here. In point of fact, the ably-executed translation from the original German occupies but 371 pages out of the 576 of which that volume is composed, the remainder being made up of Appendices by Mr. Ellis—which will suffer little, if anything, by comparison with the work which they so worthily supplement—and a capital index. We may, moreover, add that the translator has, in addition, enriched the work throughout with foot-notes elucidating and illustrating the text. In fine, he has, in conjunction with Professor Helmholtz, produced a work which should, and soon must, be on the shelves of every physicist, mathematician, and scientific musician in the kingdom.

Audeography, the New Shorthand. By Digamma. Lithographed from MS. (London: Bemrose & Sons.)—This is a work which may be commended to our occasional correspondent, Mr. J. Greevz Fisher, and others who fondly believe that they are practising a phonographic system—in the rigid sense of writing words as they are pronounced. "Digamma" knows better. "Whatever attributes," he says, "Phonography may enjoy, its most perfect exponent can never be accused of *writing by sound.*" Having reduced matters to this comfortable stage,

our author proceeds to develop his own system, which is apparently composed of diagrams of sea-gulls in flight, fly-dirt on windows, and worms which have been trodden on, similar to those which characterise most modern works on stenography. As "Digamma" attacks phonographers as a class, they will doubtless possess themselves of his book and answer him.

We have also on our table, *The Journal of the Society of Arts*, *The Child's Pictorial*, *The Season*, *The Medical Press and Circular*, *The Tricyclist*, *Wheeling*, *Bradstreet's*, *The Sanitary News*, *Le Franklin*, *The Belfast News Letter*, *The Northern Whig*, and, from the Messrs. Cassell, *Cassell's Household Guide*, *Cassell's Popular Gardening*, *Our Own Country*, *European Butterflies and Moths*, *The Book of Health*, *The Library of English Literature*, and *The Countries of the World*.

THE FACE OF THE SKY.

From Sept. 11 to Sept. 25.

By F.R.A.S.

The usual examination of the sun will be made for spots and faculæ. The aspect of the night sky is shown on Map IX. of "The Stars in their Seasons." There will be a minimum of Algol on Sept. 12 at 6h. 54m. p.m. Mercury is a morning star, and attains his greatest elongation west of the sun (17° 51′) at 7 p.m. on the 18th. He may be seen with the naked eye about this time, glittering close to the eastern horizon before sunrise, by any one who will get up (or sit up) for that purpose. He exhibits a very pretty little crescent in the telescope. Venus is indifferently placed for the observer, and, moreover, her position steadily deteriorates. She is an evening star, and as a telescopic object is seen as a small gibbous disc. Mars, Jupiter, Uranus, and Neptune continue invisible. Saturn, though, is nightly improving in position for the observer's purpose, continuing to form a triangle with μ and ν Geminorum. He rises before 11h. p.m., when our notes begin, and just after 10 o'clock at night, when they terminate. The moon enters her first quarter at 6h. 14·8m. on the morning of the 16th, and is full at 7h. 54·7m. a.m. on the 21th. At this time she will be partially eclipsed. The first contact of her limb with the penumbra, though, will occur at 5h. 2·1m. a.m., and she will set (at Greenwich) at 5h. 45m., so that beyond a very slight darkening of her following limb nothing of the eclipse will be visible here. The occultations of fixed stars observable during the next fortnight are fairly numerous. To begin with, on Sept. 19, 13 Capricorni, a star of the 6th magnitude, will disappear at the moon's dark limb at 8h. 4m. p.m., at an angle from her vertex of 122°, and reappear at her bright limb at 9h. 23m. p.m., at a vertical angle of 272°. Later, at 9h. 33m. p.m., 14 Capricorni, a 5th mag. star, will disappear at the dark limb at an angle of 151° from the Moon's vertex, to reappear at her bright limb at 10h. 41m. p.m., at an angle from her vertex of 273°. On the 20th, 18 Aquarii, a star of the 6th magnitude, will disappear at the dark limb at 6h. 47m. p.m., at a vertical angle of 49°. It will reappear from behind the bright limb at 7h. 55m. p.m., at an angle of 305° from the vertex of the Moon. On the 21st, B.A.C. 7774, a 6th magnitude star, will disappear at the dark limb at 10h. 8m. p.m. at an angle from the Moon's vertex of 136°; reappearing at her bright limb at 11h. 22m. p.m., at a vertical angle of 283°. Lastly, on the 25th, μ Piscium, a star of the 5th magnitude, will disappear at the bright limb at 8h. 12m. p.m. at a vertical angle of 94°; and will reappear at the dark limb at 9h. 9m. p.m., at an angle of 233° from the vertex of the Moon. When our notes begin the Moon is in Virgo; but at 9h. 30m. to-morrow morning she crosses into Libra. Passing through Libra, she arrives, at 8 a.m on the 14th, on the confines of the narrow northern strip of Scorpio. This she takes 10 hours to cross, and at 6 o'clock the same afternoon enters Ophiuchus; whence at 4 p.m. on the 16th, she passes into Sagittarius. At 6.30 a.m. on the 19th she quits Sagittarius for Capricornus, and Capricornus in turn for Aquarius at 3 a.m. on the 20th. She is travelling through Aquarius until 7 a.m. on the 23rd, when she enters Pisces. She has not completed her journey through this huge constellation when our notes terminate.

The Dutch State Railway authorities have been conducting experiments on the behaviour of different paints for ironwork. They have shown that red lead best resists the action of the atmosphere. It was found, also, that the coat holds better on iron plates cleaned by pickling than when the plates have been scraped or brushed. The trial sheets were pickled with hydrochloric acid, washed with warm water, dried, and oiled while still warm.

Our Inventors' Column.

STATE-ROOM LADDER.

[Patent No. 14,065. 1884.]—This invention, by Mr. Thomas James, of 25, Earle-street, Liverpool, is intended to meet the "upper berth" difficulty in passenger vessels, the difficulty and danger of reaching or leaving the upper berth in rough weather forming one of the most serious discomforts which sea-travellers have to undergo. In its simpler form, the invention consists of a wooden step-ladder 6 or 7 ft. high, joined to the bulkhead or partition forming the head or foot of the berths by a support about 3 or 3½ ft. long. The support is connected to the ladder and to the bulkhead by hinge arrangements, so that the ladder can be drawn out for use, and, when not required, closed up against the bulkhead out of the way. To add to its security, strong hooks are attached to the side to clamp the edges of the bunks. When drawn out, the foot of the ladder will be about 4½ ft. and its head about 2 ft. from the bulkhead, the foot being kept in position by a cord, and the ladder kept closed by a clip, catch, or similar arrangement.

By means of this ladder, the upper berth passenger can reach his berth without danger or annoyance to the lower passenger. It will be much easier and safer to use than ladders hung to or leaning against the upper berth, which slip and fall with the least motion, while, after using it, the ladder ceases to be an obstruction in the state-room, as with ordinary ladders.

PUBLIC TELEPHONE CHECKING MACHINE.

[Patent, No. 13,543. 1884.]—This machine, by Mr. Mann, of Manchester, consists of a clock train and a rocking lever, fixed in a box containing upper and lower compartments. The upper compartment contains the connections to battery, line-wire, and transmitter, and mechanism in connection with the clockwork for regulating the time during which the connections are made for speaking. The lower compartment is a receptacle for metal tokens or coins, which are used to set the mechanism in motion.

The tokens or coins are placed into a hole in a brass segment, and are passed on to the rocking lever by turning a handle; the lever is thereby canted over until the coins slide off and drop on to a tray, allowing the lever to return to its original position; simultaneously, electrical contact is made, which transmits the "ring-up" signal to the central-office, and a bar is raised opposite to the slider, and retained in position by a crank. On receiving the "return-ring" from the central-office a button is pressed, thereby raising levers, which complete the transmitter primary circuit, changing the signal from off to on, and liberating time disc. The necessary connections with the central-office are now complete until a notch in the disc comes opposite the end of one of the levers, and the contact pin against the spring, when further movement is arrested. On the receipt of the "reply-ring" from the subscriber, the button is again pressed, completing the transmitter circuit for a definite period of time, during which the disc travels round until the above-mentioned lever drops into the deep end of a slot and transmits the "ring-off" signal; simultaneously, the apparatus is restored to its original position, and the signal is changed from on to off, when the cycle of operations is complete. By means of a releasing arrangement the tray is allowed to fall every time the instrument is used, thereby allowing the coin of the previous operator to drop into a drawer beneath.

SAMPHIRE SOAP.

When the mountain declined to come to Mahomet, Mahomet, with a fine sense of the fitness of things, went to the mountain. Those whose inclination and means enable them to sojourn at the sea-side, are of course able to indulge in the health-giving luxury of sea-bathing To those prevented by circumstances from doing so, the Messrs. J. C. & J. Field offer a substitute in their Patented Samphire Soap, for which a Gold Medal was awarded to them at the Health Exhibition in 1884. No attempt has been made in the specimen before us to load this soap with the heavy perfume of any essential oil. There is a whiff of the sea in the scent which it emits in use, which is eminently suggestive of its hygienic properties. It is very pleasant on this account to use.

The death is announced of an eminent French railway man, M. Paulin Talabot. Born in 1800, he passed unscathed through all the tremendous vicissitudes of French politics, and died at the ripe age of eighty-five. Even then his death appears to have been the result of an accidental fall. M. Talabot will long be known and remembered as the originator of the vast system of railways bearing the designation of the Paris, Lyons, and Mediterranean. M. Talabot was also actively associated with great dock works at Marseilles, as well as with other important public undertakings.

TO CORRESPONDENTS

"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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OCULAR SPECTRA—DARWINISM.

[1917]—It is with sincere regret I pen these lines, as they are probably my last effusion to KNOWLEDGE—at any rate for some time. In a few days I shall be starting for a voyage half round the globe, in the hopes of hindering for a while the ravages of an incurable disease. But, before I go, I feel it incumbent on me to reply to the Conductor's note (1864) and to your constant correspondents F. W. H. and Mr. Cave Thomas (1861). F. W. H. requests that I will read Haeckel's "Pedigree of Man" for myself. I own the soft impeachment. I have not read Haeckel's "Pedigree of Man." I accepted as accurate F. W. H.'s quotations. I did not think it necessary to spend x shillings on the book (I am within reach of no good library) to prove that Haeckel's syllogisms were fairly sound when I cannot admit his definitions. But, if ever I come within reach of the book, I will read it, and, if possible, let F. W. H. know the result.

Mr. Cave Thomas says (instead of answering my objection to his statement that "ocular spectra have no *external existence whatever*") that it is not clear that I am intimately acquainted with the phenomena in question. If it will help Mr. Thomas in any way, let me assure him that I am, and have been for many years. Mr. Thomas says I object to the statement that ocular spectra had no *objective* existence. I know nothing of objective or subjective. I am perfectly willing to agree with Dr. Lewins, if he wishes it, that everything is subjective, or with somebody else that everything is objective; but I should not feel much wiser. What I objected to was "external existence whatever." I was under the impression that in such discussions external meant physical, and that the nerves of the eye were as much external as the pigments on the leaves of the spectra book. The only thing that can possibly have no external existence is the mind which perceives. Every sensation must have a corresponding physical phenomenon. Even if the mind can excite sensations, it can only do so by first acting on the matter which produces them

The Conductor's note is, "Mr. Alexander should go to Darwin's books for Darwin's ideas." But I have gone, and when I went I took notes. I grant it is a dozen years ago, but I still have the notes written, with Darwin's books at my right hand. It is true Darwin never speaks of a single pair, but nevertheless he uses the term common progenitor in the singular, and he certainly means that the two branches, man and gorilla, meet the common stem higher up than the point at which the carnivora meet it.

I am under the impression also that he uses some such argument as follows to account for the peacock's tail. A cock bird of the pheasant genus by a sport of nature developed a tail with a brilliant spot or spots. This so attracted the admiration of the hen birds of his day that nearly all the next generation of cock pheasants in his locality had spots on their tails, and so on for each succeeding generation until the peacock in all his glory. What I wished to draw attention to was that Darwin seemed hardly satisfied with the explanation that it was the nature of plants and animals to evolve higher types. He tried to show how each species had varied, and that generally it was due to natural or to sexual selection. Darwin seemed rather to come to the conclusion, that if left alone variations had a natural tendency to revert to the original type.

JOS. W. ALEXANDER.

AMERICANISMS: "A BIT."

[1918]—The term "bit," in my time in the States, beginning in '48, was applied to a small Mexican coin, value on its face for six and a-quarter cents. It passed current for six cents, and was known by the name of a Mexican bit, or a fippenny bit as pronounced. There was in circulation at same time a Mexican coin of double the value of the bit (*i.e.*, twelve and a-half cents), and this coin was known by the name of a Mexican sevvey. The common expression "that's a sevvey, or that's a bit," to distinguish either from a five or a ten-cent piece, was in general use up to the year '52. From this date onward the word sevvey and the coin disappeared; but the term "bit" was applied to five cents, and occasionally to three cents, but seldom to ten cents. The origin of the terms date from the introduction of the coins by the U.S. troops on their return from the Mexican War, which ended in 1847, and the coins came into free circulation in the middle and southern sea-board cities in the years named. At the present you would not find a coin of either denomination in the States, but the term remains. It was in Mexico that the late General Grant first saw active service. J. BYRME.

MISPRONUNCIATION.

[1919]—Another instance of "words in common use among the natives (of India), but derived from English," is to be found in the expression "Jam do," generally employed by the signalmen on the Indian railways when they desire that a danger-signal, or one implying that the line is "jammed," or blocked, should be exhibited.

G. H.

THE GAME OF DRAUGHTS.

[1920]—I am glad to see that Mr. A. E. Hodson, in letter No. 1884, does not let the assertion quoted in letter No. 1856, to the effect that the game of draughts is played out, pass unchallenged. In addition to Mr. Hodgson's remarks, I would like to quote an extract from the *Newcastle Weekly Chronicle* for April 24, 1880, where we find a few figures given to show that there is at least a *little* play left for those who wish to amuse themselves with draughts, or "checkers" as the Americans call the game.

"A young man (A. L. Myers), a clerk in an hotel at Wilmington, O., was fancied and taken along by a travelling artist on account of his great skill with the pen and brush. Being a checker player besides . . . he said the beauties of the game captivated, and its capabilities fairly astonished him, and he intended to turn eastward and locate in some great checker centre, where he could indulge his leisure in contests with players of note. He fancied Philadelphia. This young aspirant to checker fame certainly filled the measure of his ambition, for he discovered a draw for the whites in a variation of the 'Old Fourteenth' opening that stood in Sturge's work for seventy-five years as a sure win for the black men, and so pronounced by every famous player. . . ."

Lastly, R. E. Bowen, one of the ablest analytical and impromptu players living, gives these interesting figures as to the inexhaustibility of checkers. He says:—"To know how many variations we shall have, we have only to decide how many moves there shall be in a game. The match played between Wyllie and Martins in 1864 seems to be about an average. There were sixty-two games and 4,001 moves, average over sixty-four moves to a game—suppose we make it sixty. I find we shall have the following surprising number of variations:—1,152,921,504,606,846,976. If 40,000,000 people could play together at the same time, each couple playing one game every ten minutes, ten hours a day, and three hundred days a year, it would take them one million six hundred thousand two hundred and seventy-nine years to play the above number of games. If the games were printed in a series of books, 2,000 variations in each book, they would make 576,460,752,303,422 volumes. If these books were the size of the 'American Draught Player,' they would form a wall 200 ft. wide and 590 high around the world—25,000 miles—and yet we hear men talk of grinding up all its wrinkles. The game of checkers is far more profound than human knowledge can fathom: its ever-varying position cannot be solved. The true position will never be written; though one had the brain of an Anderson, the years of a Methusalah, and the wealth of a nation, he would not unfold a hundredth part!" (Originally published in the *Turf, Field, and Farm.*)

From this extract we learn that we are liable to attacks by some who imagine the game is exhausted, but a little theoretical analysis will soon dispel this illusion. Mr. Bowen is no mere talker. In 1880, he published 940 variations on the "Bristol" opening, commencing from the *third* move of the trunk game, and probably in half-a-dozen years, a hundred improved methods of play will be discovered on these games. But should any player become tired of draughts and fancy he knows all about it, I can safely recommend him to the Polish game on the Major board of 100 squares to drive any remnant of conceit out of his mind. The British champion

draught-player, Mr. James Wyllie, gives as his opinion that chess and draughts are "magnificent but navigable rivers in comparison to Polish draughts, which is as boundless and unfathomable as the mighty ocean. Nevertheless, there is more in English draughts than the wisest of us can comprehend in a life-time." So much for the opinions of the champions. J. Wallis.

ON THE INDIAN WEAVER BIRD.

[1921]—Among the many marvels exhibited out here by nature with a liberal hand, none, I think, can approach the pendulous nest of the Indian weaver, or, as it is more familiarly known, the Baiya-bird. It is a finch, and its African cousins are known as sociable gross-beaks, and are famous for their aggregate straw-nests. Our baiya is *facile princeps* among bird architects, inasmuch as it virtually launches its frail pendulous nest from nothing into nothing.

All other birds have a foundation of some sort or other to commence from, and their nests, more or less, rest upon, and are supported by such foundation, but this bold and unique architect, starting, say, from a straw in the the thatch of your bungalow, or from the spiny end of the pinnule of a date-palm, or from the thorn of a mimosa, launches forth its wondrous structure to the fostering care of the atmosphere, being well aware that it will for ever know but little rest.

Careless alike of zephyr or gale, just moving under the kiss of the former, or agitated by the blast of the latter, the brave little birds resolutely carry on their building and nesting operations.

Why do they affect pendulous nests? When I was at the Cape many years ago, one of our boyish haunts was a large oval willow-fringed pond, each tree of which was hung with the waving pendulous nests of the weaver birds.

We were greatly impressed with them, and more so with the reason assigned for them by Herr Jurgens, the owner of the pond; the nests were pendulous to keep off snakes and monkeys. We were obliged to be satisfied with this explanation, though there were neither snakes nor monkeys in the neighbourhood. The reason is equally difficult out here; for neither snakes nor monkeys could possibly reach the nests. The work of construction, simple enough to the little architect, is one of great magnitude to the observer, and at times difficult to follow, even under the closest observation; for it must be borne in mind the little bird works downwards literally from nothing.

Note that straw projecting from the thatch of your verandah, for a golden-headed cock baiya has spotted it too. Perhaps you had wondered what all the chatteration in the adjoining neam-tree was about. But you did not for a moment dream that a colony of weaver birds was going to monopolise your verandah. But so it is; and presently you see a weaver hovering around that straw with a long streamer of green grass in its beak; and, while you look, in some marvellous manner, one end of the grass ribbon is fastened to the straw, how, you can't say, for the process is so rapid. After that it is hopeless to attempt to follow the marvellous downward progress of the little architect, but you see the fairy fabric steadily lengthening downwards towards completion.

The only two points you can fix are—at first, the little bird weaver on the wing; then, when it has a footing, it works downwards, clinging to the apex of its nest.

Baiyas almost always build from the date-palm (*Phœnix Dactylifera*), or from the babul (*Acacia Arabica*); and, what is very curious, they prefer the neighbourhood of railways, and each season they build fresh nests in fresh localities.

There has been much fanciful writing about these nests, some writers describing the basket-shaped nest of the male, in which he perches and surveys approvingly the work of the colony. This is simply an unfinished and abandoned nest. There is another fable which has equally no existence, that of the firefly stuck in to illuminate the nest.

The only real story lies in the fact that some of them weight their nests with mud; but this is the exception and not the rule. When the mud does exist, it is found on the little ridge between the bowl of the nest and the tube of exit.

Wonderful as an architect, this little bird is equally wonderful as a comic actor of the highest order. So docile is it, and so apt to learn, that it may be taught anything.

Native women wear little discs of coloured and gilded glass on their foreheads. A lover will tell his baiya to bring him the disc from his lady's brow, and the command is at once obeyed. Or he will bid it take a cardamom to her lips, with equal success.

A silver two-anna bit may be dropped into a well, and, arrested in its flight by the baiya, be brought back to the hand of its owner.

But these are comparatively minor performances. Let us attend to this man, who presents himself with a troupe of performing baiyas, all of whom are prevented from flying away by a soft thread passed round their loins. Making his salaam, he asks permission to exhibit; that accorded, he commences his patter:—

A Sepoy has deserted to the enemy, has subsequently been captured, and is now before them. He is to be tried by court-martial, and, if convicted, is to be blown from a gun. The traitor is placed on the ground, and takes up a dejected position; the court is also deposited, and at once commences chattering. Presently an ominous silence ensues, during which a little cannon, a ramrod, and a pellet of gunpowder are produced and laid ready. One baiya takes up and drops in the pellet, another drives home the ramrod, and a third seizes the cord of the trigger.

While a pinch of powder is being placed on the touch-hole, the prisoner, with drooping head, takes up a position two feet in front of the cannon; the court now draws up in a solemn line behind the cannon, and one takes the fatal trigger-cord; bang goes the piece, and the culprit drops; the court hops up, and forms a circle of chatterers around the body, which suddenly revives, and a free fight all round ensues.

After this military spectacle, we are treated to a religious one. The man rigs up a little wooden mosque, on the platform of which the members of the late court-martial take up their places as a line of worshippers, led by a moulvie. Under his guidance they accurately go through the nimaz, and then hop off and assist in dismantling the mosque.

Such are some of the interesting features exhibited by this interesting little finch, and they illustrate strikingly its constructive and imitative powers. R. F. Hutchinson, M.D.

Pachmari, July 26, 1885.

P.S.—We have two other weavers, or rather sewers, out here, each very wonderful in its way—the dear little mite of a tailor-bird, which sews the edges of leaves together for its nest; and the fierce mata, or great red ant, which sews together the edges of a terminal bunch of mango leaves. Approach one of these nests carefully, and give it a tap, in a moment the exterior will be covered with fierce brown-eyed warriors, all standing erect on their hind legs, and discharging formic acid into the air, the effects of which are soon felt in your eyes if you are near enough. Those who are afraid of the yellow wasp send for a red-ants' nest, and place it near that of the wasps, which clear out in no time.

PHILOLOGICAL.

[1922]—Tennyson and Wagner have made us familiar with an alleged "Holy Grail." Unless there is positive evidence that "Sangreal" is two words, there is, I think, a much more obvious origin.

It was fabled to be the vessel of which Jesus, at the Last Supper, said, "This cup is the new covenant in my own blood." Now, the linen napkin on which the Host lies at Mass is called "corporal," the receptacle of the body. By analogy, the chalice should, or might have been called "sanguinal." In Spanish (and other Romance dialects, probably) *sanguis* becomes *sangre*, *sangrinale* would then become *sangreäl* (three syllables). There you have the natural name of the vessel at once, without any "holy," or any "grail."

"Whitsuntide" has never had its derivation settled; but it seems allowed that *sun* is part of the word, and does not belong to *Sunday*; so that we should pronounce, not "Whit Sunday," but "Whitsun Day." This is the Feast of the Holy Ghost. "Wit," in primitive English, signified "spirit" as well as "ghost" did; "saint" was a Latin word learned from the Church services. Then would not "Wit Saint" be likely English for "Holy Ghost?" These suggestions are so beautifully simple that I fear that, if true, they would have occurred to somebody before. Hallyards.

A GOOD TRICYCLE FOR A HEAVY WEIGHT.

[1923] In reply to "Sixteen and a-half stone," the best tricycle for a rider of such a weight would be a front-steerer; either Starley's Salvo or Starley & Sutton's front-steering Meteor, he would find a specially strong and safe machine well-suited for his purpose. The Globe Leni is a well-made machine, with which I have no doubt he would be satisfied.

I would recommend him on no account to have any machine that is convertible. Single machines, being simpler, are much less liable to get out of order. John Browning.

TRICYCLE.

[1924] If Mr. Browning (whose series of articles on matters connected with bicycles and tricycles have been of much interest) would kindly let your readers know whether he has tried the Crypto-Dynamic Two-speed Gear, to which the gold medal has been awarded at the Inventions Exhibition, and if he has tried it, with

what results, I think it would be very useful to persons hesitating as to its adoption. Many authorities have spoken highly of it, but I should like Mr. Browning's opinion thereon. G. W. G.

LETTERS RECEIVED AND SHORT ANSWERS.

One who, &c. I have not seen the paragraph about the vegetarian society, so that your attack has been misdirected. Nor have I attacked sunspottery (an abominably ugly word which I only quote from your letter, never using it myself). As for the Astronomical Society, I have never even thought of attacking it anywhere. I should have to withdraw from it first. But possibly you did not know I am a Fellow of the Society. I have never to the best of my knowledge and belief read one line of the *Dietetic Reformer*, or expressed any opinion about it, good, bad, or indifferent. You are all at sea. *Did* I "get into a mess with another well-known astronomer"? I have no recollection of the circumstance. I imagine you are at sea there also. "Take your word!"—the word of one who writes anonymously! That is asking too much. There is always the bare possibility that such a man may by some accident speak the truth. But the chances are enormously against it. It is safest at any rate to read everything he may aver by the rule of contraries. I adhere to my opinion that I have seen your writing before, and naturally I am strengthened in the opinion by your denial.—R. H. Barrett. I fancy the author of that review had heard the "hysterical shrieking" he referred to. *You* write sensibly enough. But all total abstainers do not either write or speak so calmly and pleasantly. "Practically, if not totally, abstainers"—what would that mean? I fancy it would include me. For certainly, the alcoholic liquor I take in a week, would be thought by many who are by no means heavy drinkers, to be a moderate allowance for a day. It is the men who see hell in a half-pint of beer whom the reviewer had—I suspect—in his mind's eye.—J. The point is of more interest than you seem to think. I wish you had indicated the particular Americanisms which you "have heard all your life in the very centre of England." Some, I knew, were good old English, But have you heard "no-account" as an adjective, "allow" for *assert* or *believe*, "not anything else" for *just that*, "approbate" for *approve*, "at that" for *added to that*, "the balance" for *the rest*, "bee" for a gathering of friends, "biscuit" for soft rolls, &c.? I have heard more "dialect" than you seem to think, and have read largely old English books and plays; but I should regard as an Americanism a phrase which, though English in origin and still used in parts of England, is understood by *all* Americans. The expressions "my *word*" and "no *fear*" in like manner I regard as Australian, though they are often enough heard in England. "I guess" is found in old English writers, and in some as late as Locke's time; yet it is an Americanism now. One often hears "I reckon" in England even to this day; yet it may be called an Americanism of the Southern States, because there used constantly. I wonder by the way how many expressions like "I want to know" (to express surprise), "I swan to man" (as a euphemism for "I swear to God," and the like, can be traced to an English source. Of course "You may bet your bottom dollar" is as necessarily American as "You pound it" (which I suppose means, "You may wager a pound on it") is English.—Hallyards. You are right. There has been misunderstanding. Certainly I never saw the letter you sent after me. I should not have been very much surprised by the remarks of that American (though a brother Cantab might have known better than to be misled by them). My being invited by the editor of the American "Cyclopædia" to write the astronomy for that work, created a simple frenzy of anger among certain Americans who had expected to be asked. Still I have said (and thought) so many pleasant things about American students of astronomy, that I might have hoped to be more fairly construed; doubtless there were mistakes on both sides; I overrated them and they underrated me: we need not rate each other. One of the most amusing examples of the feeling you refer to came to my knowledge at Washington. An American lady remarked to the wife of a well-known astronomer (or rather mathematician) at Washington that she was glad I had come to live in America: "Are you?" said Mrs. N., "well, I'm not; America doesn't want Proctor; it has N.!" This was particularly amusing to an unofficial student of astronomy, like myself, utterly innocent of any idea of trespassing on that official astronomer's manors. But that is the worst fault of official science; your scientist with a salary growls over it as a dog growls over a bone which he fancies every passer-by hankers for. Of course, I had unwittingly taken N.'s expected bone, but I had not gone after it; I was invited to take it; and as he is not a good writer, no one but himself had expected he would have it. I remember the same man groaning in spirit, in conversation with myself, because more was known about Mädler in America than about any American astronomer. I believe by the way that no one has done so much or one-tenth so much as I have to make American astronomers known to European readers. I am for my own part slow to imagine envy, which seems to me a strange, and must be a most uncomfortable feeling. My ideas about that vice were impressed on me very strongly when I was a boy. I used to see almost every day, at Chelsea, the Cadogan motto on old Cadogan pier (then new): *Qui invidet minor est*. I understood the words ("he who envies is less") but not the sense. Asking my father the meaning of the motto, he not only told me, but impressed the thought deeply on my mind by adding to his interpretation these words: "My boy, you will have to acknowledge yourself less than others often enough as you go through life: but try *never* to acknowledge it by envy: envy is the meanest possible way of admitting inferiority." Since then, in watching my own mind, I have learned to look with suspicion even on the feeling of emulation, unless it comes, as it should, in company with hearty admiration. The companions of Envy we know—does not the Litany tell us who they are?—Hatred, Malice, and all Uncharitableness. With regard to the letter to the acting editor, there was nothing in it to move anger. I am sorry I judged you wrongly; but your remark to him that he ought to feel so and so about such and such matters, seemed to me rather unfair. (I acquit you now freely of intended unfairness. I only found out, at that point, that I was reading a letter not addressed to myself.) Unless I deceive myself, and I don't think I do, you are utterly mistaken about my temper, as I think I told you in 1882. I know I was much readier to be warm ten years ago than I am now. I have even been somewhat anxious, in a passing sort of way, lest Wendell Holmes's explanation might be the right one, that mellowing indicates over-ripeness. I certainly do not care two straws *now* about some things which used to stir me somewhat at the time when you say I was "extremely and unnecessarily courteous to you." But are you not a little apt to misunderstand things? For example, that "Sadie D. Crowley" joke of mine. "Disingenuous to disavow!" Good gracious! what an interpretation to put on what I said! An impertinent newspaper writer had spoken about a number of strictly private and personal matters, with that curious mixture of truth and falsehood—one truth to fifteen fibs—which makes their rubbish so unpleasant to friends and relatives of the persons they drag into their columns. Among other blunders he got two mistakes (*not* misprints, but blunders arising from his ignorance of the families he pretended to talk about) in one name! Disavowing that doubly-blundered name was my way of casting deserved ridicule and condemnation on the whole preposterous story. As you yourself point out, the right name was published—in the right way—soon after: that should have prevented you from adopting so absurd a notion as that I wanted to disavow the matter, disingenuously or otherwise. Besides, you ought to understand and sympathise with my indignation at what assuredly was gross impertinence. How far my wrath has been moved "*in æternum*" against you by the G. E. matter, you shall judge from this, that, on my word, if any one had asked me, just before I read your letter, (I mean your last one, to which I am now replying) whether you were or were not one of those who had taken part in the attack I deprecated, I should have been quite unable to answer. I do not now remember what you said, or whether I read anything from you on that subject. Did I reply to you by name?—Your coleopterist priest was mistaken, as my bank-book would testify. In justice to a contributor you ought not to have quoted his remark. Your praise is as little deserved as your censure; I have neither the splendid genius nor the hot temper you imagine. I have worked as well as I could and as hard as I could, where I found work to do, and under difficulties which few would guess; but any man of decent capacity who cared to try, on the same lines, would, *me judice*, have got through the same amount of work and done it as well. It is the want of resolution and will, and perhaps the want of occasion (I don't say of opportunity, for I have not been very fortunate in opportunity) which has kept many out of my field of work.—I should have written what I have, privately in reply to your private letter; but for the wish expressed at the end of it. The readers of Knowledge (those at least who, having read what I said before, read this also) can gather from my reply that we shake hands in all good fellowship. I am going, however, to offer one piece of advice which I trust you will take as it is meant. Such sayings as those of your French priest, your American astronomer, and other persons unnamed, ought never—in my opinion—to be repeated. In some cases—as in that of the American astronomer, whom you describe as one of my American friends—such stories are calculated to leave a vague but unpleasant effect. For example, I have but one friend among American astronomers. I had another, who is dead. I am fully certain that neither of these, both being to my knowledge gentlemen of noble disposition, said the enviously malicious and untrue things you report. I am left, if I think about the matter at all, to attribute the remark to two or three others whom I have met: but of whom I do not know enough personally to decide whether they *can* or can *not* be ignoble enough to fit into the story. And as regards the publication of such things, even to

ridicule them, you may not know, so well as I do by experience, the effect such publication invariably has on some minds. If you were to say in a letter in KNOWLEDGE, "They are so ignorant in—Basutoland—as actually to suppose that So-and-so"—naming some worthy bishop—"is in reality a Mahometan,"—you would find, soon after, some people going about asking "Is it *really* true, as reported, that Bishop So-and-so is a believer in Mahomet?" Your moon magnification ideas are quite wrong, and in justice to readers I cannot print your letter. Your multitudinous telescopes would have overlapping fields,—the sky does *not* overlap. Your argument like Mr. Williams's about the appearance of the sun as supposed to be seen from moon during total eclipse, is based simply on misconception. I have tried to *explain*, not to *controvert*: and have failed. Mirage never shows non-existent things. And mirage has nothing to do with the apparently magnified moon. Your experiment when the range of the sky was reduced would have been more to the purpose if you could show that you diminished your consciousness of the moon's horizontality. My note of admiration honestly expressed my wonder at your being puzzled—with your wonderful facility at inventing explanations, possible or impossible.—A satellite could be released from its primary, or a planet from the sun, so far as never returning is concerned: but you definitely spoke of bodies travelling in straight lines. That indeed was your special point.—I never supposed, and certainly never implied, that you wilfully misquoted me. I thought I dealt very pleasantly, and as it were smilingly, with your rather resolute attempt to maintain that I had said what I knew I had not said. As for the "double haves," I decline to judge the English language by the French (which is full of incorrectness) or by any other. "To see" means seeing, "to have seen" means seeing in the past, and of either one may say, speaking either indicatively or conditionally according to the circumstances,—It *is* pleasant, it *was* pleasant, it *has been* pleasant, it *might have been* pleasant, it *would have been* pleasant, or anything else one may please, let Mark Twain or the French or any other grammar say what it will.—SAMPHIRE. Mr. Slack does not need to be told that the plural of the word "imago" is "imagines": he simply prefers "imagoes" as the plural of the anglicised word "imago"; just as we say "indexes" rather than "indices." There is enough affectation about such matters without asking for more. Do not know the exact nature of the change by which a lobster's shell turns red under the action of hot water.—IGNORAMUS. Ask why the whipping-top ceases to spin and you will not be far from guessing why a rotating planet needs no flogging.—COMMENTATOR. Your letters just received, like the others, are too mixed in structure: suggestive questions mixed with wild semi-religious fancies, and attempts at more or less positive answers about the unknown and even about the unknowable. Do not know "Gamma's" address. The letters are all ready for return as you request. But is the address at the head of your letter sufficient? As to the personal matter, regret rather than wrath was predominant, and unfortunately remains. Would that you had been in London to cancel as you think you would!—R. LEWINS. I must by your own account view Hylo-idealism from the standpoint of self; and if I tremble at it, or am otherwise affected by it, I tremble at self or am otherwise affected by myself. (And yet I am not myself in being so affected.) Well then, I must judge by myself, and judging by myself I reject Hylo-idealism as for me quite meaningless.—COURTNEY FOX. Thanks: shall have however sufficient reports.—C. WOOLLY. Thank you.—BERKS. Very probably.—S. F. B. PEPPER. Is that science worth acquiring?—J. JACKSON. Am away from back numbers and volumes. The publishers of a book ought to attend to such business.—W. S. C. The *millions* more likely to be wrong than the *one*. The lines are Shakespeare's, and mean that though art may find means to improve on nature, those means are of nature's own making. As an example one may take some fancy specimens of pigeons, which may be regarded as an improvement on the rock pigeon an improvement obtained by artificial means—but through natural laws.—H. A. L. S. Chess will be duly supplied: but the freshness of Chess news is not a point we can regard as of very great importance. Exactness is much more important—just as (to take an illustration from the game itself) correct play is better than quick play.

THE FIRST AMERICAN FOUR MASTED SHIP.—Early in August, the first four-masted ship ever built in America was launched at Rockland, Maine. This new craft is 2,628 tons burthen, measuring 291 ft. in length at water-line. The frame is Virginia oak, and the plank southern pine. The masts are solid, the main sticks being Oregon pine and 90 ft. in length. The main truck is 181 ft. above the deck, the main yards are 90 ft. in length, and the rigging carries 1,200 square yards of canvas. The cost of this craft complete will be about 150,000 dols., nearly £31,000, or about £11. 15s. per ton.—*Engineering*.

Our Chess Column.

By MEPHISTO.

SCOTCH OPENING.

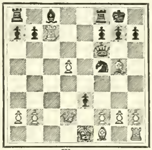
ILLUSTRATIVE GAME No. 10.

IN reference to the attack of 7. Q to Q2 in the Scotch Gambit, we have promised to give some games actually played, showing the best defences against that move. In the annexed game will be found one way of meeting 7. Q to K2, that is by B × Kt. The "Chess Monthly" says that it is "a perfectly satisfactory continuation, which simplifies the position, if anything, in Black's favour." We do not quite agree to this. The continuation is right in itself; we think, however, that Black has better moves at his disposal. We hope to give a game to that effect before long.

GAME PLAYED AT THE NUREMBERG TOURNAMENT, JULY, 1883.

	White. L. Paulsen.	Black. A. Schottländer.
1.	P to K4	P to K4
2.	Kt to KB3	Kt to QB3
3.	P to Q4	P × P
4.	Kt × P	B to B4
5.	B to K3	Q to B3
6.	P to QB3	KKt to K2
7.	Q to Q2	B × Kt (*a*)
8.	P × B	P to Q4
9.	Kt to B3 (*b*)	P × P (*c*)
10.	P to Q5 (*d*)	Kt to Kt sq. (*e*)
11.	Kt to Kt5	Kt to R3
12.	R to B sq. (*f*)	Castles
13.	Kt × BP	Kt × Kt
14.	R × Kt	Kt to B4
15.	B to Kt5	P to K6 (*g*)*
16.	B × P	Q to K4
17.	R to B3	R to Q sq.
18.	B to B4	Kt to Q3
19.	B to Q3 (*h*)	Kt to K5
20.	B × Kt	Q × B
21.	Castles	Q × P
22.	Q × Q	R × Q

BLACK.



WHITE.

* The above was the position after the 15th move.

Given up as a draw.

NOTES.

(*a*) This is a sufficient answer as far as 7. Q to K2 is concerned. It is no disadvantage to Black to have White's Pawn posted on K4 and Q4, as the latter P is unsupported, and will not be able to move to Q5, on account of P to Q4, which follows next move. On the whole, however, the game assumes a drawn aspect.

(*b*) With the intention of getting his Kt into play if Black plays P × P. White has, however, yet another move which deserves notice, that is 9. B to QKt5, which, of course, prevents Black from playing either P × P, on account of 10. P to Q5, or Castling, *i.e.*, 9. B to QKt5, Castles. 10. B to Kt5, Q to K3. 11. Castles, KR, and White has a fairly developed position.

(*c*) Black has nothing better. If he plays B to K3 White would reply with 10. B to Q3, putting Black in an uncomfortable position, as White threatens P to K5.

(*d*) With a view to disorganise Black's game.

(*e*) If Kt to Q4, then 11. Kt to Kt5, and Black could not defend the BP so well as after Kt to Kt sq.

(*f*) White could have obtained a much superior game by playing 12. P to Q6.

(*g*) An excellent device to gain time. See diagram.

(*h*) If any other move, then Kt × B, followed by R × P.

CHESS PLAYING.

SIR,—The Chess Congress at Hereford, which you did us the favour to report, was a brilliant success. There arise, however, after-thoughts in the minds of many Chess players and non-Chess players—*cui bono* all this expenditure of time, money, and brain-power? I would reply, the result should be *great good*. Chess playing ought not to be a recreation only, but a useful study. Proficiency in the game is undoubtedly an indication of intellectual power. Professor Ruskin (in a letter to me a short time ago) said he should like to see Chess a class-subject in all schools. Without aspiring at present to quite as high a standard of usefulness, I am content to take lower ground, but only as a step to higher. A degree in Mathematical honours at Cambridge (Mathematics and Chess require like talents) is undoubtedly a great help to a man, either as a candidate for a post of duty or in

the duty itself, and I would plead that Chess should give like advantages, which would necessarily be more universal in their nature, for while a degree at the University is comparatively only within reach of the few, a high position in Chess may be obtained (after home study, club practice, &c.) by attending our Chess meetings. The meetings are annual, and continue a week, beginning on a Monday evening and terminating the following Saturday about noon. The local secretary gives full information as to lodgings, hotels, &c., to suit all purses, and the Congress, both in respect of time and money, is made as far as possible accessible to all.

The Hereford meeting was a particularly *class* representative one, not only by its patrons and supporters, but especially by its competitors, among whom were one of her Majesty's Inspectors of Schools, a master of an important National School, young men from Oxford and Cambridge, young clergymen and lawyers, clerks in offices, men in trade, &c., &c., ladies married and unmarried, along with many of the best living masters.

Taking very briefly another view, a Chess tournament tests very severely a person's patience, perseverance, temper, straightforward conduct, and general bearing towards others.

I arrive now at the *practical.* Let me venture to say that "The Counties' Chess Association" (an institution of twenty years' standing, and well recognised) would be glad to give certificates of attained proficiency after the ordeal of tournament, and such certificates could be countersigned by the president, say, of the club to which the person belongs, and to whom he would probably, in some way, be known in private life. Let such certificates, I would appeal to the general public, be considered as valuable additional recommendations. In Germany Chess helps a man to a useful life; may it do so, and in a higher degree, in England! The importance of the subject must be my apology for trespassing on your space.—I am, Sir, yours obediently,

A. B. Skipworth, Hon. Sec.,
Counties' Chess Association.

Tetford Rectory, Sept. 5, 1885.

Miscellanea.

A statement has just appeared in the *Cologne Gazette* of the cost of restoring and completing the great cathedral from 1823, when the work was resumed after a neglect of nearly three-quarters of a century, down to April 1 of the present year. The amount, including a contribution of 250,000 marks from the cathedral tax, was 21,000,000 marks, or £1,050,000. This is quite independent of gifts of valuable objects for the religious services or the decoration of the building, and of a large number of private donations and funds for pious foundations.

A bored tube well, 300 ft. deep, lined with extra strong wrought-iron tubes from the surface to the chalk, has recently been completed by Messrs. C. Isler & Co., on the premises of the Belfast and London Aërated Water Company, on Bankside. The chalk was reached at 204 ft. from the surface, after passing through 36 ft. of peat and gravel, 75 ft. of London blue clay, 93 ft. of mottled clays and light and brown sands with pebbles (Woolwich and Reading beds). Many objectionable springs were met, especially in the gravel bed overlying the London blue clay. These have been safely excluded from the well by means of the tubes, which are of even size, driven some distance into the chalk, preventing therefore any percolation from above. The supply is pumped direct from the chalk springs, at the rate of 72,000 gallons per day, whereas deeper wells, dug on the old principle, within a short distance, fail to yield sufficient quantities.

A new Transalpine line, the St. Bernard Railway, is likely to be commenced before very long, and to be, when completed, a dangerous competitor for the through traffic with the already existing route of St. Gothard. One of the principal features of the new project is that the indispensable tunnel under the Alps—at the Col Ferret—will be very much shorter than any other, either constructed or proposed to be constructed. The length will be only 9½ kilomètres (5¾ miles), while the Gothard tunnel is 15, (9¼ miles), the Mont Cenis 12, and those under the Simplon and Mont Blanc 20 and 19 kilomètres respectively. The total length of the St. Bernard line will be but 138 kilomètres, or 86 miles, making a saving between London and Brindisi over the St. Gothard route of 59½ miles.—*Engineer.*

Concerning glass-making, the *American Manufacturer* says:—"In the manufacture of glass fifty years ago 28 lb. of potash and 26 lb. of wood ashes were used to every 100 lb. of sand. The first change from this was to burn the potash in an oven, and work it as a puddler does iron, in order to obtain better results; and this was used with lime in about the same proportions as potash and wood ashes above named. Soda ash was first used in New Jersey, but its introduction in Western factories was very rapid, and the mix was changed to 33 lb. soda ash and 26 lb. of lime to 100 lb. of sand. The proportions vary greatly with circumstances and the quality of the ingredients used. The following is a fair statement of the mix now mostly used: Soda ash, 40 lb.; lime, 30 lb.; sand, 100 lb. For salt cake, 33 lb.; soda ash, 10 lb.; lime, 33 lb.; pulverised charcoal, 2½ lb.; arsenic, 1½ lb.; sand, 100 lb. If the glass is muddy, the charcoal is reduced; if too green, charcoal is added and arsenic reduced."

Contents of No. 201.

NOTICES.

Part XLVI. (August, 1885), now ready, price 1s., post-free, 1s. 3d.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, SEPTEMBER 18, 1885.

CONTENTS OF No. 203.

THE NEW STAR IN THE ANDROMEDA NEBULA.*

THERE are three theories of the universe, rising step by step in grandeur, on which the remarkable discovery of a new star in the Andromeda nebula throws light. Grand as is the conception of a process by which the whole of the solar system had its birth and growth, with its mighty and beneficent central sun, its families of planets of various orders, giant planets and earth-like planets, minor planets and secondary planets, with all the multitudinous orders of meteoric and cometic systems, the thought is yet more overwhelming in its grandeur that that system is itself but a unit among millions—nay, thousands of millions—of such systems. Each star is a sun, and as there are many orders of planets so are there many orders of suns. There are suns like Sirius, and Vega, and Altair, the blue-white stars, so far surpassing our own that he compares with them as Saturn or Jupiter with him, as our earth with Jupiter, or as the least of the asteroids with the earth. There are orbs again, the yellow-white stars, which are veritably our sun's brother suns, so like are they to him in structure. There are others, the orange-coloured stars, whose vaporous envelope has so far cooled as to absorb large portions of their lustre. Others yet, the red and garnet-tinted stars, are suns whose light is so darkened by their absorptive atmospheres that we must regard them as in solar decrepitude. And finally, there are bodies, the dark suns, whose light no longer penetrates their cooled envelopes; they are orbs which we cannot see, but whose existence we can occasionally trace in the perturbing influences they exert upon their nearest neighbours.

Here, then, is a system, not only grander than our solar system in this, that its components are themselves solar systems, but presenting probably a far greater variety of structure, since so many millions of bodies form those parts of it which are visible because self-luminous. We can picture to ourselves, however, a yet grander system even than this. As there are systems of solar systems—a whole galaxy of such systems—so doubtless there are systems of such galaxies. Many orders of galaxies we may conceive to exist in such a higher order of systems. Infinite must be indeed, to our conceptions, the variety prevailing among many millions of galaxies, each, like our own, containing multitudinous orders of solar systems, each of these in turn as varied as our own. We may pass even beyond the system of galaxies, and conceive with Kant the idea of systems of such systems, of systems of systems of such systems, and so on, to higher and higher orders absolutely without end. But our actual knowledge does not extend beyond the galaxy or system of solar systems; and it can never extend beyond systems of galaxies, even if it should ever extend so far.

It is on this point, indeed, that the remarkable discovery just made throws clearest light. It tells us certainly what one or two reasoners had already shown to be all but certain—that we have no evidence of galaxies external to our own. If there was one among the 5,000 known star-clouds about which it might still be plausibly maintained that it is a remote galaxy of stars, the great Andromeda nebula—"the transcendently beautiful queen of the nebulæ," as the old astronomers loved to call it—was the one. Because of its great apparent size Sir William Herschel regarded it as the nearest of the stellar nebulæ. Unlike the great irregular nebula in Orion—called, less poetically, the Fish-mouth nebula—the queen of nebulæ was not suspected of being gaseous even when Sir William Herschel adopted the belief that many nebulæ are mere masses of luminous gas or star-mist. The spectroscope in the skilful hands of Dr. Huggins had shown conclusively that the Andromeda nebula shines with such light as comes from the stars, as if it were a mighty congeries of suns.* A sudden degradation of the spectrum near the red end indicated great absorptive action by vapours surrounding this sun-like matter; and that had naturally suggested doubts as to whether the nebula can be a galaxy like our own, the leading members of which give under analysis all colours of light from the deepest red to where the spectrum faints away in darkest violet. But as one star differs from another in glory, so may one galaxy be unlike another; as there are young suns and old suns, and dying suns and dead suns, so even may galaxies be in different stages of galactic life. The arguments by which it had been shown that probably no single external galaxy is within telescope range were not based on any evidence which the telescope or the spectroscope had given about the great nebula in Andromeda considered individually, but on certain peculiarities of nebular arrangement which show that the nebulæ belong to our own stellar system. The Andromeda nebula was perhaps the one star-cloud which might possibly be an exception to this rule. It is very large, yet not resolvable into separate stars, though formed apparently of such bodies, since it gives star-light; no other nebula among all the 5,000 known to astronomers can be compared with it in this respect.

The recent discovery, however, entirely disposes of the possibility that even this great nebula can be an external galaxy. That a star of the eighth magnitude should be visible in the heart of this great cloud of star material, shows that the star-cloud cannot possibly lie at the immense distance formerly imagined as at least

* From the *Times*.

* There are, however, no dark lines in the spectrum, as I erroneously implied last week. See letters which follow.—R. P.

possible. If the Andromeda nebula were an outlying galaxy of the same size as our own, it must lie at a distance exceeding at least a hundred times that of the remotest star in our galaxy. Now the stars in the outermost part do not give one-thousandth part of the light of an eighth magnitude star. Removed a hundred times farther away those outlying stars would be reduced 10,000 times in lustre, and so would not give the 10,000,000th part of the light which comes to us from the star now shining in the Andromeda nebula. It would have to be 30,000 millions of times larger than our sun, if its surface-lustre resembled his—and it has been shown by St. Claire Deville and others that we cannot safely assume a much greater surface-lustre than our sun's to be even possible. If we admitted the sudden development of such an appallingly stupendous mass as this, the bare possibility of so wonderful a sun forming in the heart of a star-cloud would prevent our admitting the belief that that star-cloud could be a galaxy like our own. Thus the outburst of the new sun definitely negatives the belief that any external galaxies are within range of our keenest telescopic vision. The grand thought that there is a system higher than the stellar system, a system of galaxies, must remain, probably for ever, a conception—like the Kantian idea of yet higher orders of systems.

But as to the system of solar systems, the discovery just made gives positive evidence of the most interesting kind. While compelling us to draw the nebulæ back, as it were, from the remotely external position which had been assigned to them, it enhances our conceptions of the variety and vitality within the mighty system we *can* explore. Enabling us now definitely to regard all orders of nebulæ as part of our stellar system, it teaches us to see in that galaxy a complexity of structure far surpassing, as we might have anticipated, even the amazing complexity we had already recognised in the solar system. We not only see within the stellar system all the varied orders of suns, and all the wonderful varieties of arrangement among suns—double, triple, and multiple groups, clustering aggregations, streams, branches, nodules, and far-reaching clouds of suns—but we see all the varied orders of star cloudlets—globular, elliptical, ring-shaped, and spiral, resolvable and irresolvable, star dust, and star vapour—within the bounds of the same marvellously variegated system. We recognise also not only all the stages of sun-life already noted, not only the evidence of solar decay and death, but evidence of changes which imply the first stirrings of solar life. In vitality, as in variety, the great galaxy is to our conceptions infinite, even as it is infinite in extent and in duration.

The following letters have also appeared :—

"Respecting the new star in Andromeda it is announced from Brussels that at the commencement of August the stellar nucleus was not visible. Mr. Isaac W. Ward, however, reports having seen it on August 19, at 11 p.m. It was also seen at Rheims, by M. Lajoye, on August 30, and also independently by Mr. G. T. Davis, of Theale, near Reading, on September 1. The Dun Echt telescopes show it as a veritable 7½ magnitude star, with a fairly continuous spectrum. On September 3, Lord Crawford and the undersigned found that the Nova is most probably situated some 1·6s. preceding and 5″ south of the old nucleus, which is much overpowered by the light of the star. "RALPH COPELAND."

"With reference to the remarkable change that has taken place in the great nebula 31 Messier in Andromeda, I was fortunate enough to obtain an observation of it last night with my 10½ inch Calver reflector. The new star was estimated at about 7·5 magnitude, orange-red in colour, and very hazy, not showing a clean disc with any power; it was followed by a most minute point of light at about twenty to thirty seconds of arc, the space between being darker and apparently devoid of nebulous matter. Whether this latter was a star or merely a 'knot' in the nebula I could not determine owing to want of light.

"A change of such magnitude in a nebula which has hitherto resisted all attempts to resolve it into stars is an event of such importance that it is to be hoped no opportunities will be lost to detect any further change that may take place, and no doubt the spectroscope will prove most valuable.

"As Mr. Knobel points out, it may be only the outbreak of one of those extraordinary variable stars of which T Coronæ (the "Blaze" star of 1866) is a good example; but I venture to think some great change has been taking place in the nebula itself, for as far back as the beginning of July I found the central portion much more condensed than usual, and so bright as almost to convey the idea of a stellar nucleus, although no absolute star point was visible. The evidence of actual change at this time, however, was not conclusive enough to warrant a public announcement. KENNETH J. TARRANT."

"I have received a memorandum on the above subject from the Rev. S. H. Saxby, of East Clevedon, Somerset, from which, by his permission, I extract some interesting particulars.

"On August 6, Mr. Saxby, who was then at Davos, observed the nebula, and remarked its singular brightness. On August 9, which was a very clear night, he examined it again, and describes it as follows:—'The whole central portion of the nebula was strikingly bright. . . . . There was no sign whatever of a stellar nucleus, nor was there anything which could so much as raise the question of the existence of one. The centre of condensation was purely nebulous, and the condensation was not abnormally rapid.' Mr. Saxby also examined the spectrum of the nebula, hoping that he might be able, on so clear a night, to detect some bright lines in it, but 'got nothing more than the usual dull, continuous spectrum, deficient at the red end,' although the nebula in Vulpecula showed its bright lines readily. The following night, August 10, gave precisely the same results.

"On returning to England Mr. Saxby examined the nebula again on Sept. 3, at 9.30 p.m., and was astonished to see a bright star in its centre, and at once communicated his discovery to me. The next morning he learned of Dr. Hartwig's prior observation of the change.

"I may add that I examined the spectrum of the new star at the Royal Observatory on Friday, Sept. 4, with the large 'half-prism' spectroscope devised by the Astronomer-Royal, and found it to be of precisely the same character as that of the nebula—*i.e.*, it was perfectly continuous, no lines, either bright or dark, being visible, and the red end was wanting. There is, therefore, at present no evidence of any outburst of heated gas, as was the case with the 'temporary' stars T Coronæ in 1866, and 'Nova' Cygni in 1876.

"The star itself was very easily seen in the finder of 3 in. aperture attached to the large refractor of the Royal Observatory. "EDWARD W. MAUNDER."

"The new star in Andromeda was observed here on Saturday and Sunday nights, Sept. 5 and 6. It is very nearly of the seventh magnitude, and of a yellow colour, similar to Arcturus, with continuous spectrum. It is

situate about twenty seconds of arc preceding and ten seconds south of the nucleus of the nebula, which, in consequence of the proximity of the new star, has ceased to be conspicuous. There is no sort of doubt that this is a new star. No star is mentioned in any of the descriptions of the nebula as existing in that position, nor shown in any of the drawings.

"Yesterday I was permitted to examine the photograph taken by Mr. Common in August, 1884, in which there is no trace whatever of the star, although the plate is covered with very much fainter stars. It was a mere chance that this interesting picture was preserved, for he regarded it as a failure because of defects of instrumental adjustment.

"It is improbable that the new star is in any way physically connected with the nebula.

"G. L. TUPMAN."

[This idea is of course disposed of now by the spectroscopic evidence, which proves beyond doubt that the star is in the midst of the nebula.—R. P.]

"Your anonymous correspondent, in the *Times* of September 8, says 'that a star of the eighth magnitude should be visible in the heart of this great cloud of star material,' &c. Again, Mr. Tarrant, in the same issue, says the star on September 4 was 'very hazy, not showing a clean disc with any power.' The inference from both these statements is that the star is to be deemed an outcome of and intimately connected with the nebula. I think it worth while to point out that, as I saw the star on September 3, my conclusions would be just the other way. I was especially struck with the remarkable sharpness of the star in my 6 in. Grubb refractor; and the conclusion forced itself irresistibly on my mind that the star was an independent outburst of light physically detached from the nebula, in front of it, and, therefore, optically projected on the nebula, but having no other connection with it. The point is one of great interest and importance, and it would be worth while to know what other observers may say. Nor did I notice the orange-red colour seen by Mr. Tarrant. However, the exhibition of such colour would in general be a ground for supposing that the star was probably a variable or temporary one, and, therefore, independent altogether of the nebula. "G. F. CHAMBERS, F.R.A.S."

"Mr. Chambers has apparently overlooked the evidence given by the spectrum of the new star. The identity of this spectrum with the characteristic spectrum of the nebula proves beyond further question that the star is physically associated with the nebula. It would have been a strange chance that a star, really much nearer, should by chance have appeared in the very heart of the most interesting nebula in the heavens, and a yet stranger chance that a new star, appearing somewhere else, should have shown the same peculiar spectrum as the Andromeda nebula; but that both these chances should be combined is altogether incredible. To this we may add that we have other reasons for regarding stars in nebulæ as physically associated with the nebulous matter amid which they seem immersed. The most wonderful variable star in the heavens, Eta Argûs, is in the very heart of the great Keyhole nebula in the keel of the star-ship Argo. Now, that star outshone in 1840 even Canopus, the second star in the heavens for splendour, and rivalled Sirius, the first. It is now barely visible on the darkest and clearest night. Imagine that nebula ten times as far away and we should have had in the outblazing of Eta Argûs the apparent formation of a new star. But the most decisive evidence was given by the new star in Cygnus in 1876, without which, indeed, the coincidence of Eta Argûs in position with the great Argo nebula might still be regarded as signifying no physical association; for that new star shone out in the midst of a nebula not before detected, but still visible in the place where that star had its short career of splendour.

"Mr. Tarrant's observation of September 3, combined with Mr. Chambers's of September 4, proves that the new star and the nebula are actively disturbed. The star's seeming change of position, if confirmed, will be worth watching.

"The sudden appearance of the new star is decidedly the most interesting astronomical discovery—or rather event, for the discovery was inevitable—since Adams and Leverrier calculated the place of the as yet unknown Neptune. It disposes finally of the theory that the nebulæ are, or may some of them be, external galaxies. Mr. Herbert Spencer, in 1859, gave three or four convincing reasons showing that the nebulæ cannot be external to our galaxy; and ten years later (not knowing of this work) I repeated those, and supplemented them with many others, and with maps of nebular distribution demonstrating to the eye that the nebulæ belong to our system. Some of these reasons and illustrative statistics I presented at a Friday evening lecture at the Royal Institution in May, 1870. The views I then urged were precisely those which the new star, regarded as physically connected with the Andromeda nebula, has made certain, and, what is more, obvious and clear to all.—Yours obediently, "RICHARD A. PROCTOR."

"Scarborough."

"SIR,—It seems at present to be improbable that the new star in the Andromeda nebula will remain visible to us very long; it has already become much fainter. Last night (Sept. 9) the star was conspicuously less bright than when first seen on Sept. 3; the total diminution of light as determined with a limiting aperture photometer being nine-tenths of a magnitude. On Sept. 4 it was four-tenths of a magnitude less bright than on Sept. 3, and on Sept. 9 the brightness had still further diminished five-tenths of a magnitude. The star is of a yellow colour, about 20″ distant from the real nucleus of the nebula, 112″ from a small star preceding it, and 228″ from a similar small star nearly south of it.

"With reference to Mr. Chambers's letter in the *Times* of to-day, I can only say that the object appears in an $8\frac{1}{2}$ in. reflector distinctly star-like under all powers from 60 to 500. But in extinguishing it with the limiting aperture photometer it goes out somewhat peculiarly, which I attribute to it being superposed upon the bright ground of the nebula—the fact being that the star in that observation does not become blotted out, but only reduced to the same brightness as the luminary surface of the nebula when it becomes indistinguishable from that surface. As a matter of fact, on Sept. 9 the new star was extinguished with an aperture of 2·81 in., with the special apparatus I employ. In the monthly notices of the Royal Astronomical Society for March, 1881, I have recorded that the brightest portion of the Andromeda nebula is extinguished with an aperture of 1·95 in., using the same apparatus. This is confirmed by recent observations, suggesting that no change in the brightness of the nebula itself has taken place.

"Hence by any such photometric method it will be difficult to determine the absolute magnitude of the new star referred to an ordinary star seen on the dark background of the sky.—I am, sir, your obedient servant,

"Bocking, near Braintree." "EDWARD B. KNOBEL.

SCIENCE AND EDUCATION.*

By Sir Lyon Playfair.

VARIOUS Commissions have made inquiries and issued recommendations in regard to our public and endowed schools. The Commissions of 1861, 1864, 1868, and 1873 have expressed the strongest disapproval of the condition of our schools, and, so far as science is concerned, their state is much the same as when the Duke of Devonshire's Commission in 1873 reported in the following words:—"Considering the increasing importance of science to the material interests of the country, we cannot but regard its almost total exclusion from the training of the upper and middle classes as little less than a national misfortune." No doubt there are exceptional cases and some brillant examples of improvement since these words were written, but generally throughout the country teaching in science is a name rather than a reality.

The Technical Commission which reported last year can only point to three schools in Great Britain in which science is fully and adequately taught. While the Commission gives us the consolation that England is still in advance as an industrial nation, it warns us that foreign nations, which were not long ago far behind, are now making more rapid progress than this country, and will soon pass it in the race of competition unless we give increased attention to science in public education. A few of the large towns, notably Manchester, Bradford, Huddersfield, and Birmingham, are doing so.

The working classes are now receiving better instruction in science than the middle classes. The competition of actual life asserts its own conditions, for the children of the latter find increasing difficulty in obtaining employment. The cause of this lies in the fact that the schools for the middle classes have not yet adapted themselves to the needs of modern life. It is true that many of the endowed schools have been put under new schemes, but, as there is no public supervision or inspection of them, we have no knowledge as to whether they have prospered or slipped back. Many corporate schools have arisen, some of them, like Clifton, Cheltenham, and Marlborough Colleges, doing excellent educational work, though as regards all of them the public have no rights, and cannot enforce guarantees for efficiency.

A return just issued, on the motion of Sir John Lubbock shows a lamentable deficiency in science teaching in a great proportion of the endowed schools. While twelve to sixteen hours per week are devoted to classics, two to three hours are considered ample for science in a large proportion of the schools. In Scotland there are only six schools in the return which give more than two hours to science weekly, while in many schools its teaching is wholly omitted. Every other part of the kingdom stands in a better position than Scotland in relation to the science of its endowed schools.

The old traditions of education stick as firmly to schools as a limpet does to a rock; though I do the limpet injustice, for it does make excursions to seek pastures new. Are we to give up in despair because an exclusive system of classical education has resisted the assaults of such cultivated authors as Milton, Montaigne, Cowley, and Locke? There was once an enlightened Emperor of China, Chi Hwangti, who knew that his country was kept back by its exclusive devotion to the classics of Confucius and Mencius. He invited 500 of the teachers to bring their copies of these authors to Pekin, and, after giving a great banquet in their honour, he buried alive the professors along with their manuscripts in a deep pit. But Confucius and Mencius still reign supreme. I advocate milder measures, and depend for their adoption on the force of public opinion. The needs of modern life will force schools to adapt themselves to a scientific age.

Grammar-schools believe themselves to be immortal. Those curious immortals—the Struldbrugs—described by Swift, ultimately regretted their immortality because they found themselves out of touch, sympathy, and fitness with the centuries in which they lived. As there is no use clamouring for an instrument of more compass and power until we have made up our mind as to the tune, Professor Huxley, in his evidence before a Parliamentary Committee in 1884, has given a time-table for grammar schools. He demands that, out of their forty hours for public and private study, ten should be given to modern languages and history, eight to arithmetic and mathematics, six to science, and two to geography, thus leaving fourteen hours to the dead languages.

No time-table would, however, be suitable to all schools. The great public schools of England will continue to be the gymnasia for the upper classes, and should devote much of their time to classical and literary culture. Even now they introduce into their curriculum subjects unknown to them when the Royal Commission of 1868 reported, though they still accept science with timidity. Unfortunately, the other grammar-schools which educate the middle classes look to the higher public schools as a type to which they should conform, although their functions are so different. It is in the interest of the higher public schools that this difference should be recognised, so that, while they give an all-round education and expand their curriculum by a freer recognition of the value of science as an educational power in developing the faculties of the upper classes, the schools for the middle classes should adapt themselves to the needs of their existence, and not keep up a slavish imitation of schools with a different function.

The stock argument againt the introduction of modern subjects into grammar-schools is that it is better to teach Latin and Greek thoroughly rather than various subjects less completely. But is it true that thoroughness in teaching dead languages is the result of an exclusive system? In 1868 the Royal Commission stated that even in the few great public schools thoroughness was only given to 30 per cent. of the scholars, at the sacrifice of 70 per cent. who got little benefit from the system. Since then the curriculum has been widened and the teaching has improved. I question the soundness of the principle that it is better to limit the attention of the pupils mainly to Latin and Greek, highly as I value their educational power to a certain order of minds. As in biology the bodily development of animals is from the general to the special, so is it in the mental development of man. In the school a boy should be aided to discover the class of knowledge that is best suited for his mental capacities, so that, in the upper forms of the school and in the university, knowledge may be specialised in order to cultivate the powers of the man to their fullest extent. Shakespeare's educational formula may not be altogether true, but it contains a broad basis of truth—

> "No profit goes, where is no pleasure ta'en;—
> In brief, Sir, study what you most affect."

The comparative failure of the modern side of school education arises from constituting it out of the boys who are looked upon as classical asses. Milton pointed out

* From the opening address at the meeting of the British Association.

that in all schools there are boys to whom the dead languages are "like thorns and thistles," which form a poor nourishment even for asses. If teachers looked upon these classical asses as beings who might receive mental nurture according to their nature, much higher results would follow the bifurcation of our schools. Saul went out to look for asses and he found a kingdom. Surely this fact is more encouraging than the example of Gideon, who "took thorns of the wilderness and briers, and with these he taught the men of Succoth. (Judges viii., 16.) The adaptation of public schools to a scientific age does not involve a contest as to whether science or classics shall prevail, for both are indispensable to true education. The real question is whether schools will undertake the duty of moulding the minds of boys according to their mental varieties. Classics, from their structural perfection and power of awakening dormant faculties, have claims to precedence in education, but they have none to a practical monopoly. It is by claiming the latter that teachers sacrifice mental receptivity to a Procrustean uniformity.

The universities are changing their traditions more rapidly than the schools. The *via antiqua* which leads to them is still broad, though a *via moderna*, with branching avenues, is also open to their honours and emoluments. Physical science, which was once neglected, is now encouraged at the universities.

As to the seventy per cent. of boys who leave schools for life-work without going through the universities, are there no growing signs of discontent which must force a change? The Civil Service, the learned professions, as well as the army and navy, are now barred by examinations. Do the boys of our public schools easily leap over the bars, although some of them have lately been lowered so as to suit the schools? So difficult are these bars to scholars that crammers take them in hand before they attempt to leap; and this occurs in spite of the large value attached to the dead languages and the small value placed on modern subjects. Thus, in the Indian Civil Service examinations, 800 marks as a *maximum* are assigned to Latin, 600 to Greek, 500 to chemistry, and 300 to each of the other physical sciences. But if we take the average working of the system for the last four years, we find that while 68 per cent. of the *maximum* were given to candidates in Greek and Latin, only 45 per cent. were accorded to candidates in chemistry, and but 30 per cent. to the other physical sciences. Schools sending up boys for competition naturally shun subjects which are dealt with so hardly and so heavily handicapped by the State.

Passing from learned or public professions to commerce, how is it that in our great commercial centres, foreigners—German, Swiss, Dutch, and even Greeks—push aside our English youth and take the places of profit which belong to them by national inheritance? How is it that in our colonies, like those in South Africa, German enterprise is pushing aside English incapacity? How is it that we find whole branches of manufactures, when they depend on scientific knowledge, passing away from this country, in which they orginated, in order to engraft themselves abroad, although their decaying roots remain at home? The answer to these questions is that our systems of education are still too narrow for the increasing struggle of life. Faraday, who had no narrow views in regard to education, deplored the future of our youth in the competition of the world, because, as he said with sadness, "our schoolboys, when they come out of school, are ignorant of their ignorance at the end of all that education."

The opponents of science education allege that it is not adapted for mental development, because scientific facts are often disjointed and exercise only the memory. Those who argue thus do not know what science is. No doubt an ignorant or half-informed teacher may present science as an accumulation of unconnected facts. At all times and in all subjects there are teachers without æsthetical or philosophical capacity—men who can only see carbonate of lime in a statue by Phidias or Praxiteles; who cannot survey zoology on account of its millions of species, or botany because of its 130,000 distinct plants; men who can look at a tree without getting a conception of a forest, and cannot distinguish a stately edifice from its bricks. To teach in that fashion is like going to the tree of science with its glorious fruit in order to pick up a handful of the dry fallen leaves from the ground.

It is, however, true that as science teaching has had less lengthened experience than that of literature, its methods of instruction are not so matured. Scientific and literary teaching have different methods, for while the teacher of literature rests on authority and on books for his guidance, the teacher of science discards authority and depends on facts at first hand, and on the book of Nature for their interpretation. Natural science more and more resolves itself into the teaching of the laboratory. In this way it can be used as a powerful means of quickening observation, and of creating a faculty of induction after the manner of Zadig, the Babylonian described by Voltaire. Thus facts become surrounded by scientific conceptions, and are subordinated to order and law. It is not those who desire to unite literature with science who degrade education; the degradation is the consequence of the refusal.*

A violent reaction—too violent to be wise—has lately taken place against classical education in France, where their own vernacular occupies the position of dead languages, while Latin and science are given the same time in the curriculum. In England manufacturers cry out for technical education, in which classical culture shall be excluded. In the schools of the middle classes science rather than technics is needed, because when the seeds of science are sown, technics as its fruit will appear at the appointed time. Epictetus was wise when he told us to observe that though sheep eat grass, it is not grass but wool that grows on their backs.

Should, however, our grammar schools persist in their refusal to adapt themselves to the needs of a scientific age, England must follow the example of other European nations, and found new modern schools in competition with them. For, as Huxley has put it, we cannot continue in this age of "full modern artillery to turn out our boys to do battle in it, equipped only with the sword and shield of an ancient gladiator." In a scientific and keenly competitive age an exclusive education in the dead languages is a perplexing anomaly. The flowers of literature should be cultivated and gathered, though it is not wise to send men into our fields of industry to gather the harvest when they have been taught only to cull the poppies and to push aside the wheat.

The widening of the bounds of knowledge, literary or scientific, is the crowning glory of university life. Germany unites the functions of teaching and research in the universities, while France keeps them in separate institutions. The former system is best adapted to our habits, but its condition for success is that our

* This remark may be read both ways. There are students of science foolish enough to refuse from their side.—R. P.

science chairs shall be greatly increased, so that teachers should not be wholly absorbed in the duties of instruction. Germany subdivides the sciences into various chairs, and gives to the professors special laboratories. It also makes it a condition for the higher honours of a university that the candidates shall give proof of their ability to make original researches. Under such a system, teaching and investigation are not incompatible. In the evidence before the Science Commission many opinions were given that scientific men engaged in research should not be burdened with the duties of education, and there is much to be said in support of this view when a single professor for the whole range of a physical science is its only representative in a university. But I hope that such a system will not long continue, for if it does we must occupy a very inferior position as a nation in the intellectual competition of Europe. Research and education in limited branches of higher knowledge are not incompatible. It is true that Galileo complained of the burden imposed upon him by his numerous astronomical pupils, though few other philosophers have echoed this complaint. Newton, who produced order in worlds, and Dalton, who brought atoms under the reign of order and number, rejoiced in their pupils. Lalande spread astronomers as Liebig spread chemists and Johannes Müller biologists, all over the world. Laplace, La Grange, Dulong, Gay Lussac, Berthollet, and Dumas were professors as well as discoverers in France. In England our discoverers have generally been teachers; in fact, I recollect only three notable examples of men who were not—Boyle, Cavendish, and Joule. It was so in ancient as well as in modern times, for Plato and Aristotle taught and philosophised. If you do not make the investigator a schoolmaster, as Dalton was, and as practically our professors are at the present time, with the duty of teaching all branches of their sciences, the mere elementary truths, as well as the highest generalisations, being compressed into a course, it is well that they should be brought into contact with the world in which they live, so as to know its wants and aspirations. They could then quicken the pregnant minds around them, and extend to others their own power and love of research. Goethe had a fine perception of this when he wrote—

> Wer in der Weltgeschichte lebt,
> Wer in die Zeiten schaut, und strebt,
> Nur der ist werth, zu sprechen und zu dichten.

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

XVII.—SHOES AND RUNNING.

I HAVE to congratulate the Editor on his escape from a volley of correspondence controverting my last paper. It may be that those who would otherwise have fired at it are at this season better employed—are practically protesting by making pedestrian excursions in the exceptionally thick-soled boots which all *occasional* pedestrians find so advantageous. My own experience agrees with theirs. I have found that, towards the end of a walk of ten or twelve hours' duration with thin shoes, the soles of my feet have ached miserably, and that this peculiar aching was not suffered if thick-soled, hob-nailed boots were worn. Sportsmen (I mean those who hunt wild birds or beasts in wild regions, not poultry-yard battue-butchers) record similar experience.

How, then, are these facts to be reconciled with the principles expounded in my last? I admit the difficulty, but do not give it up as a hopeless paradox. Other facts, other experiences supply explanatory data. In the course of my wanderings I have met many tramps and others who live afoot. The demand for thick-soled boots does not present itself in their case. Some of the tramps were barefooted or thinly shod from necessity, but not all, as I have frequently seen them walking barefooted or in thin shoes, and carrying a stout pair of boots on their backs. This especially in Germany and Switzerland.

I observed an instructive difference in the foot-gear in different parts of Norway. Usually the roads are excellent, and the poorest peasant "keeps his carriage." Thick boots are common where this is the case; but there are exceptional regions that are roadless, where even a carriole cannot travel. The Jotunhjem, the Justedal, and some parts of Tellemarken are examples of this. The owners of these mountains, valleys and glaciers are lithe and much-enduring habitual pedestrians. They rarely go barefooted, and then for climbing rather than walking; but they wear shoes made as light as economy permits.

A very useful form of home-made shoe is worn in the Justedal. It is shaped like those of our "Oxonian" pattern that lace in front, but the lace extends all round, under the ankle and above the heel, being threaded along the upper part of the shoe close to its edge by running it through holes so that it passes alternately inside and outside. The leather being soft and pliable the shoe is thus drawn like the mouth of a bag close round, leaving no space for the entry of pebbles, &c. Though lightly made, these shoes hold very firmly to the feet.

Putting these facts together, we may infer that the demand for thick-soled boots by occasional pedestrians is due to an abnormal tenderness or weakness of the foot induced by habitual sedentary life and swaddling of the feet. My own sensations indicate that this particular weakness resides in the ligaments that hold the bones of the tarsus together, and that it is analogous to the weakness of ankle which creates a demand for the support of laced-up boots. I have felt it the most acutely on the first few days of a pedestrian excursion, very little towards the end of a long one, and have found that the best remedy is to bare the feet and hold them as long as possible in cold water. It is well known that this is the best remedy for a sprain or strain of the ligaments of the ankle, and I may add, by way of advice to all who are troubled with weak ankles, that instead of making them weaker by the artificial support of laced boots, they may, with patience and care, strengthen them considerably by habitually wearing shoes rather than boots, and as frequently as possible bathing the ankles with cold water. The reaction after the cold water brings a supply of blood to the part, and evidently nourishes the ligaments, especially the surrounding strap that binds and holds in their place the tendons descending from the leg muscles.

I may here mention a small invention of my own, which is useful. Instead of using ordinary shoe-strings to ordinary shoes, I lace a piece of rather strong "elastic" (the india-rubber braid sold by drapers under this name) through the holes, and knot it. The shoe may then be slipped on or off without any tying or untying.

Another successful experiment which I have tried as a pedestrian, is that of having shoes made reversible, both alike, so that if any local chafing occurs to make any part of either foot at all sore, the shoes may be reversed. This usually affords immediate relief. Besides this, all one-sided wearing by treading over is prevented by reversing daily.

It is, however, rather difficult to obtain such straight shoes. Shoemakers, though remarkably Radical in politics, are very Conservative in all that concerns their own trade, and not easily taught to carry out trade innovations. In such shoes the additional width demanded is chiefly across the middle or widest part of the sole. When this is given the large toe finds room for itself by pushing the foot outwards to the extreme limit of this extra sole breadth. Low broad heels are of course demanded in these, as in all other shoes.

It may be expected that I should say something to women of fashion about the ridiculous high heels they have lately worn for fashion's sake. Of course, I could show how unnaturally these instruments of torture strain certain muscles and paralyse others, how injurious they are to health and subversive of proper exercise, but in doing this I should be reasoning as though to rational beings, should be assuming that the people addressed are endowed with a respectable amount of intelligence, and amenable to proper motives. I beg to assure my readers that I am subject to no such delusion, have lived long enough and have seen enough of mankind and of womankind to make no such false estimate of character.

In direct contradiction to the demand of the occasional pedestrians for thick-soled and ankle-laced boots is that of *running* athletes. They are, so far as I am able to learn, unanimous in favour of very light, soft, porous, and pliable shoes. Those sold under the name of "running shoes" make an approach nearer to physiological requirements than any others commonly offered for sale. They have no raised heels, are as light, soft, and thin as is possible in affording the required protection and grip. The foot is nearly as free as if bared.

Recent observations and reflection have led me to conclude that all civilised European nations are going wrong in their habits of locomotion. We walk too much and run too little. If a man has to cover twenty miles in five hours he should not walk at the rate of four miles an hour, but should rather make the journey by alternately trotting a piece at five miles an hour and then walking about the same distance at three miles an hour. I am now convinced that fast walking is questionable or even bad exercise, and that daily discipline in gentle trotting is very desirable, our general muscular structure being better adapted for running than for the straining effort of rapid walking. A child runs spontaneously; so do men who are unrestrained by conventionality, and all enjoyable athletic games (excepting the solemn golf of serious Scotchmen, and fashionable archery) involve more or less of running.

I profoundly regret that I did not make this discovery thirty years earlier. Had I done so my present girth would be very different. One of my recent neighbours was a Hindoo rajah. This gentleman carried out a daily discipline of running a few miles—usually on the Harrow-road. On ordinary occasions he took a trot from his house and back again; at other times, as when driving to town, he ran behind his carriage. Judging from his physical appearance, he kept himself in excellent condition thereby. We should all do well to follow his example. The Rotten-row would be a still more useful institution than at present if, in addition to the soft-ground horse-way, there were a foot-track for gentlemen trotters in flannel whites, and ladies in corresponding divided skirts. Even from a spectators' point of view the interest of that popular show would be increased thereby. It would be well if all the members of the Pall-mall clubs took a trot round the Mall and Birdcage-walk preparatory to the house dinner. Members of Parliament the same. For the barristers, attorneys, and their clients, Lincoln's-inn Fields are available when the court rises. City men might run to and from the station daily instead of walking. In the country there is no difficulty.

It is very satisfactory to observe that athleticism is so rapidly superseding the dandyism of the past. One of its admirable forms is the organisation of "harriers," a party or club of youths who start rationally dressed for a ten or fifteen or twenty miles' run, and meet convivially at the end; provided always that beer and tobacco are not allowed to neutralise the benefits of the fresh air and exercise.

I need scarcely add after the above that canvas or other strong porous material is incomparably preferable to leather for the upper part of shoes. The demand for waterproof foot-covering due to that morbid condition of the feet described in my last, may be superseded by gradually releasing the feet from excess of bandage and exposing and expanding them naturally. A certain cure for "cold feet" is obtainable by frequently immersing them in cold water for a short time, then taking a sharp walk or run in thin shoes. Perseverance in this will in due time remove all real and imaginary danger of taking cold as a consequence of wet feet.

MYSTERIES AND MORALITIES.

By Edward Clodd.

VII.

THESE several pageants from the Apocryphal Gospels lead up to the most popular, because farcical, pageants of the Adoration of the Shepherds, which are common to the four series, the Towneley having two plays on the subject.

In the first of these, *Prima Pastorum*, two shepherds complain—one of the loss of his sheep, and the other of dangers from "robers" and "bosters"; when a third joins them, and, finding them quarrelling about the pasture-land, chaffs them at losing sight of the sheep. They then fraternise, and empty their bags, one bringing out, with "mustard afore," a cow's foot, a pig's leg, "two blodynges (black puddings), I trow, a leveryng (liver) betwene"; another producing "an ox-tayle," a "good py," and "two swyne gronys"; while Tercius Pastor contributes "the leg of a goys," with chekyn's endorde,* pork, partryk," and other delicacies, which they wash down with "good halsom ayle of Kely,"† this caution being given:—

Bewar now, I wynk,
For and thou drink drely in thy polle wylle it synk;

but unheeded, for says

Tercius Pastor. Be my dam soulle, Alyce, it was sadly dronken.
Primus Pastor. Now, as ever have I blys, to the botham it is sonken.

They then seek sleep, and just as the third shepherd utters this odd invocation,

Jesus O' Nazorus,
Crucyefixus;
Marcus, Andreas,
God be our spede!

they hear the angel's announcement of the birth of Jesus, the prophecies about whom they recite, the third

* A term used in cookery, said to mean *gilt over*.
† Query, Hely, *i.e.*, Ely.

shepherd capping the rest by quoting, not very correctly, and transposing the lines from Virgil:—

> Jam nova progenies cœlo demittitur alto,
> Jam rediet virgo, redeunt Saturnia regna.*

Against which such veneer of learning John Horne, the second shepherd, protests:—

> What speke ye here in myn eeres?
> Telle us no clerge, I hold you of the freres, (friars)
> It semys by youre Laton
> Ye have lerd youre Caton.†

They then repair to Bedleme (Bethlehem), and present their gifts to the babe; one offering him a box "this lytylle spruce cofer;" the second offering him a ball, saying,

> Haylle, lytylle tyne mop!
> Rewarder of mede!
> Haylle, bot oone drop of grace at my nede;
> Haylle, lytylle mylk sop! haylle David sede!
> Of our crede thou art crop,‡ haylle, in God hede!§

The third shepherd gives him a bottle, and Mary having bestowed her blessing, they depart.

In the York play, which has only fourteen stanzas, the shepherds, after hastening to find their fee,|| are startled by the angels' "noble noyse," and repair to Bethlehem, where they find the "lorde layde betwyxe tuo bestis tame," and offer him respectively a "broche by a belle of tynne at youre bosom to be;" "tuo cobill notis (cobbnuts) uppon a bande" (ribbon); and "an horne spone that will herbar (hold) fourty pese."

In the Chester pageant *De Pastoribus greges pascentibus*, dramatic propriety is scattered to the winds, the angel's appearance is made occasion of great fun, his pronunciation of "gloria" is discussed, the shepherds, rough Cheshire or Lancashire men, refresh themselves with jannocks (oatmeal-bread) of Lancashire, butter of Blacon, cheese, and Halton ale, quarrel and fight, and then at the appearance of the Star in the East, hie to Bethlehem, where one of them, Trowle, gives Jesus "a pair of his wife's old hose," and of three boys who follow them with offerings, one gives his nuthook, so that

> To pulle doun apples, pears, and plombes,
> Old Joseph shall not need to hurt his thombes.

The Coventry play is the most featureless of the four, being filled in the main with the shepherds metrical recital of the Messianic prophecies and adoration of the "babe and barne of blys."

But it is in the second play of the Towneley Series, *Secunda Pastorum*, that the comic element reaches its climax, not without value, however, in the rude yet faithful picture of old country-life set before us. As in the first play, the shepherds in turn tell their troubles; one grumbling at the cold and the taxes (they "ar fortaxed and ramyd," *i.e.*, wrongly taxed and over-reached); a second about his wife and marriage generally. Of the former he says she is—

> As sharp as thystylle, as rugh as a brere,
> She is browyd lyke a brystylle, with a sowre loten chere;
> Had she ones wett her whystyll she couthe syng fulle clere
> Hyr pater noster.
> She is as greatt as a whalle,
> She has a galon of galle,
> By hym that dyed for us alle!

* Jam redit et virgo redeunt Saturnia regna;
Jam nova progenies cælo demittitur alto.
Eclog. iv., 6, 7.

† The *Disticha Catonis*, an introductory book then used in teaching Latin.

‡ Upper branch.

§ *Towneley Mysteries*, p. 96.

|| A. S. *feoh*, cattle, property; cognate with Sanskrit *paçu*, Latin *pecus*, cattle, which first signifying flocks, gradually came to mean property in money or kind.

And of the latter:—

> But yong men of wouyng, for God that you boght,
> Be welle war of wedying, and thynk in youre thoght
> "Had I wyst" is a thing it servys of noght;
> For thou may cache in an owre
> That shalle savour fulle sowre
> As long as thou lyffys.

They are joined by a third shepherd, who complains of the floods, hard work, and low wages, these last in arrears as well; after which they seek to forget their sorrows in a song, the first agreeing to "syng the tenory," the second to "tryble so hye," and the third "the meyne," when they are interrupted by the arrival of one Mak, at whom they look askance as a man suspected of sheep-stealing, and scruple not to tell him so. After supper, and gossip about Mak's wife—

> Ilk yere that commes to man
> She brynges furthe a lakan,
> And some yeres tuo.

They all lie down to sleep, putting him between them. After this invocation:

> Fro my top to my too
> Manus tuas commendo
> Poncio Pilato,
> Cryst crosse me spede,

Mak contrives while they are snoring, to slink off with sheep on his back. Hurrying home, he knocks up his wife, when they put their wits together how best to hide the theft, and she suggests popping the sheep in the cradle and figuring lying-in. Mak agrees:

> Thou red;
> And I shall say thou was lyght
> Of a knave childe this nyght.

He then returns to the shepherds, who have not missed him, but when they wake, tell dreams about him, that he was clothed in a wolf's skin, that he had "trapt a fatt shepe." Mak meanwhile shams sound sleep, and when roused, says he dreamed that his wife had given birth to a "yong lad," and that he must hurry home. Missing the sheep, they follow him, and clamour at the door, when he begs them

> speke soft
> Over a seke woman's heede.

They charge him with the robbery, which both Mak and his wife deny, she saying through her groans.—

> I swelt (die)
> Outt, theyfys, fro my wonys! (dwelling)
> Ye com to rob us for the nonys.
> *Mak.* Here ye not how she gronys?
> Your hartys should melt.

At last, after looking about for signs of mutton, they give up the search, when, just as Mak is bidding them farewell, one of the shepherds says to another:—

> *Primus Pastor.* Gaf ye the chyld anything?
> *Secundus Pastor.* I trow not oone farthying.
> *Tercius Pastor.* Fast agayne wille I flyng,
> Abyde ye me there.
> Mak, take it to no grefe, if I com to thi barne.
> *Mak.* Nay, thou does me greatt reprefe (reproof) and fowle has thou farne.
> *Tercius Pastor.* The childe wille it not grefe, that lytylle day starne.
> Mak, with your lefe, let me gyf youre barne
> Bot vj pence.
> *Mak.* Nay, do way; he slepys.
> *Tercius Pastor.* Me thynk he pepys.
> *Mak.* When he wakyns he wepys.
> I pray you go hence.
> *Tercius Pastor.* Gyf me lefe hym to kys and lyft up the clowtt.
> What the deville is this? he has a long snowte.
> *Secundus Pastor.* He is lyke to owre shepe.
> *Tercius Pastor.* Wylle ye se how thay swedylle
> His foure feytt in the medylle

Sagh I never in a credylle
A hornyd lad or now.

Mak. Peasse byd I: what! lette be youre fare;
I am he that hym gatt and yond woman hym bare.

The wife also tries to brazen it out :—

A pratty child is he
As syttes on a woman's kne;
A dylly downe, perde,
To gar a man laghe.

Tercius Pastor. I know him by the eere marke:
that is a good tokyn.

Mak. I telle you, syrs, hark,
his noys was broken.
Sythen told me a clerk that he was forspokyn (bewitched).

Primus Pastor. This is a false wark. I wold fayn be wrokyn (revenged)
Get wepyn.

Wife. He was takyn with an elfe;
I saw it myself
When the clok stroke twelf
Was he forshapyn (transformed.*)

At last Mak gets thrashed for the theft, and the weary shepherd's rest is broken by the "Gloria in Excelsis" of the angels, of whose singing they make fun. The play concludes with the visit to Bethlehem, and the presentation to the infant Jesus of "a bob of cherys," a "byrd," and a "balle" wherewith to play "tenys."

Among the skilful imitations of Mystery Plays the *Nativity*, in Longfellow's *Golden Legend*, and the *Prologue in Heaven* in *Faust* may be mentioned. In this last-named drama Goethe has reproduced with truth and vigour the ancient conceptions of the relations between God and the archfiend, of which both the Mysteries and Moralities give so vivid a picture.

* In the *Minstrelsy of the Scottish Bards*, iii., 479, is a balladised Eskdale tradition of Archie Armstrong having stolen a sheep and placed it in a cradle, and by pretending that it was a child, deceiving those who came in pursuit of him and it. It is clear from the above that the story is much older than the time of Charles the First's banished jester. Note in Collier's *Hist. Dram. Poetry*, II., 107.

THE GREAT RED SPOT ON JUPITER.

By Richard A. Proctor.

(*Continued from p.* 200.)

LESS simple, but not less decisive is the mathematical evidence adduced by Professor Geo. H. Darwin (son of Charles Darwin), who has shown that the movements of Jupiter's satellites would be other than they are if the mass of Jupiter were distributed uniformly, or with any approach to uniformity, throughout the globe we measure as Jupiter's. Either there must be great compression towards the centre of Jupiter's globe, or the outer parts of the region within the cloud surface we measure must be of very small density, the real globe beginning thousands of miles inside that envelope.

I pass over for the moment the powerful argument derivable from the behaviour of Jupiter's satellites. But I must say that, in my opinion, when observers of great skill, like the late Admiral Smyth, Sir Thomas Maclear, Professor Pearson, Mr. Todd of Adelaide, Mr. Ellery of Melbourne, and the assistants of these last-named observers, record observations, such as the reappearance of a satellite after its transit across Jupiter's disc had already begun, and the visibility of a satellite when behind the planet and well within the disc, and the visibility of a faint star through the outer envelopes of Jupiter, it seems to me idle to advance optical-illusion interpretations such as would barely avail to explain such phenomena recorded by the merest beginners with the telescope. Thus Mr. Todd, Government Observer at Adelaide, who has had more experience than any man living in observing transits and occultations of Jupiter's satellites (having specially devoted himself to the work, in response to an appeal of Sir George Airy's), records that on four occasions he saw a satellite pass behind the well-defined edge of the planet, the form of the satellite continuing visible, without distortion, until at last the whole satellite was thus seen through the outer parts of the planet, and that on each occasion his assistant, a very cautious and well-practised observer, saw the same phenomenon. Reply is made that possibly Jupiter was a little out of focus, or his outline for some other reason indistinct, and the satellite not really seen within it, or possibly the observers (both of them!) mistook a false image of the satellite, the result of wearied eye, for the satellite itself. Surely we may say that such an explanation is inconsistent with all reasonable probabilities. A mere beginner in observation may have the edge of the planet out of focus, and suppose the blurred extension so produced to represent the real dimensions of the planet. But Mr. Todd is no mere beginner; he is an "old hand," and an old hand at this particular work. His assistant, again, is no beginner, but a practised observer. In hazy weather, again, even a practised observer might form an unsatisfactory estimate of the position of Jupiter's edge (though he would by no means see a clearly-defined outline to the satellite); but the weather was not hazy; the sky was exceptionally clear and still (so Mr. Todd told me when I had the pleasure of meeting him at Adelaide in 1880). The wearied-eye theory would be quite out of the question in the case of a single observer of any skill; but when Mr. Todd, seeing the outline of the satellite through the outskirts of the planet, called his assistant to take his place at the telescope, there was no wearied eye with a false image of the satellite on it, at work, but a fresh eye, which had not been looking at a satellite of Jupiter's for some time; and when Mr. Todd resumed his place at the telescope, his eye too was practically a fresh one. So with other recorded cases, where skilful and well-practised eyes have observed phenomena which can only be explained by recognising great tenuity in the outer cloud-laden regions of Jupiter, and a great extension of his gaseous surroundings in depth.

We seem to have travelled a long way from the great red spot, but in reality all that we have been inquiring into since we left the spot bears importantly on our interpretation of that remarkable phenomenon:

When we see so many independent lines of evidence all pointing to the conclusion that that state of things prevails to which the only valid explanation of the shape of the great red spot had already led us, all reasonable doubt seems removed. We may rest assured, I think, that the red spot really owed its symmetry of form to the central nature of the forces at work in forming it, and its elongated shape to the circumstance that regions at very different distances from the planet's centre took part in forming the spot, uprising matter being left lagging westwards and down-sinking matter being hurried for ward eastwards, instead of travelling with uniform velocities from the centre of disturbance.

But now, as soon as we thus recognise a region below the visible surface of the planet as taking part in the disturbance indicated by the great spot, it is a natural thought that possibly the origin of the whole disturbance was not only below the visible surface of Jupiter, but in

the real globe of the planet. Let us see whether this idea leads us to any results which seem to correspond with the phenomena actually presented by the great spot.

If the origin of the disturbance were in the real globe of Jupiter, then it must be presumed that the original disturbance was due to the intense heat pervading the whole frame of the planet and was explosive in character. An outburst of compressed vapour from some gigantic volcano on Jupiter, carrying upwards vast vaporous masses to regions of much diminished pressure, would be followed by the rapid rush outwards of the expanding vapour, and by the sweeping away of the cloud masses which before had covered the region of disturbance, over an immense area. This area would be circular in shape in the case of a non-rotating planet, or in the case of comparatively shallow vaporous envelopes like those which surround our earth. But in the case of masses of vapour flung upwards from the real surface of a rapidly rotating planet like Jupiter, with sufficient energy to burst their way through cloud layers thousands of miles above that surface, there would undoubtedly be a marked trailing off of the vaporous masses westwards. They would acquire a westerly motion sufficing to give the region of disturbance measurable superiority of length in an east-and-west direction. For the westerly motion would continue after the upflung vapours had reached their greatest height.

As a result of this process of westerly lagging the western end of the spot might be expected to be not quite so symmetrical in form as the easterly, a peculiarity which was actually noticed. Moreover, as the whole spot, or rather the whole of the cloud-region containing the spot would drift steadily westwards, the planet turning all the time rapidly eastwards (one rotation in less than ten hours) it follows that the spot would have a slightly longer rotation period than the equatorial markings,—which also was actually observed.

According to this interpretation, the great red spot on Jupiter would indicate the occurrence of a tremendous outburst at the planet's real surface, an outburst compared with which the great earthquake at Krakatoa was as child's play compared with the labours of many giants. That the outburst at its commencement was sudden may be well believed. Yet judging from the long continuance of the great spot and of the sequent disturbance, the eruptive action must have lasted a long time. Of course it does not necessarily follow that the disturbance which caused the great opening in the cloud envelope lasted as long as the opening itself. It may well be that the movements by which a disturbed cloud-belt on Jupiter returns to its normal condition, are sluggish compared with the fierce action by which the disturbance is brought about, at (or it may be below) the fiery surface of the planet itself. Still the gigantic elliptic ring seen as early as 1871, followed by a gigantic elliptic opening which remained for six years, and that again by a disturbed condition which has already lasted nearly three years and may last much longer,—all this seems quite inconsistent with the idea that the eruptive action giving birth (if my interpretation is correct) to this long-lasting disturbance was itself of short duration.

And after all, it would not be very surprising, when we consider the enormous scale on which Jupiter is constructed, the tremendous heat which must in all probability pervade his whole frame, and the correspondingly increased duration of all internal disturbances, if the analogues on Jupiter of volcanic outbursts which on the earth (so much smaller and now relatively aged) last often for many weeks, should on Jupiter last, occasionally, for several years. Jupiter, according to all reasonable probability, must be a very young planet. If his planetary career began at the same time as the earth's, he is certainly much younger than our earth; but even if he began his career as a planet millions of years before the earth, even then he would be younger than the earth in development. For those millions of years would be as nothing compared with the vast excess of the duration of Jupiter's life-stages over the duration of the corresponding life-stages of the earth. Regarding Jupiter as in a much more youthful stage of planetary life than the earth is now passing through, and remembering that even when Jupiter has reached the same stage as our earth his eruptive energies will be much greater than the earth's now are, we may well believe that the explosions now taking place on Jupiter must be on an incomparably grander scale than the mightiest volcanic disturbances on the earth. Applying to Jupiter the reasoning which was applied to the disturbance of Krakatoa in 1883, we might readily find that even a greater disturbance than the Great Red Spot indicated, tremendous and far-reaching though that disturbance was, could be explained, as resulting from a Jovian volcanic outburst, vaster and fiercer than terrestrial outbursts because Jupiter is at once a mightier and a much younger planet.

SCOTLAND AND SCANDINAVIA.*

By Professor Judd.

He who enters on the study of Highland geology without being prepared to encounter at every step complicated foldings, vast dislocations, and stupendous inversions of the strata can scarcely fail to be betrayed into disastrous errors.

The early history of Scotland is inextricably interwoven with that of Scandinavia. This proposition, true as it is of the insignificant periods of which human history takes cognizance, applies with even greater force to the vast epochs that fall within the ken of the geologist. To us the separation of Scotland and Scandinavia is an event of very recent date indeed; it was not only an accident, but an uncompleted accident. The Scottish Islands, with the Hebrides and Donegal on the one hand, with Orkney and Shetland on the other, must be regarded, to use a technical phrase, as mere "outliers" of the Scandinavian peninsula. The great Scandinavian *massif*, with its outlying fragments, constitutes the "basal-wreck," to employ Darwin's expressive term, of a great Alpine chain.

On other occasions I have endeavoured to show how much our study of the nature and products of volcanic action was facilitated by the existence of similar "basal-wrecks" of volcanic mountains, like those which existed in their beautiful western isles. In the same way, I believe we may learn more, by the study of this dissected mountain chain, concerning the operations by which these grand features of our globe have originated, than by the most prolonged examination of the superficial characters of the Alps or the Himalayas. Here the scalpel of denudation has laid bare the innermost recesses of the mountain masses, and what we can only guess at in the Alps and the Himalayas stand in our own Highlands clearly revealed to view.

In offering a few remarks on some of the still unsolved problems of Highland geology, I shall not hesitate to

* From Professor Judd's opening address before the Geological Section of the British Association.

treat, as belonging to the same geological district, both Scandinavia and Scotland. Not only is the succession of geological deposits in the two areas almost completely identical, but the characters of the several formations and their relations to one another in the one country are almost the exact counterpart of what they are in the other.

At the base, and forming the foundation of this greatly-denuded mountain-chain, there exist enormous masses of highly-foliated, crystalline rocks. These, in great part at least, underlie the oldest-known fossiliferous strata, and are, therefore, of pre-Cambrian or Archæan age. In spite of the labours of Kjerulf, Dahl, Brögger, Reusch, Tornebohm, and many others in Scandinavia, and of Macculloch, Nicol, and their successors in this country, much still remains to be done in studying the petrographical characters and the geognostic relations of these wide-spread formations.

Although the bold generalisation which sought to sweep all the crystalline rocks of our central Highlands into the great Silurian net have admittedly broken down, yet it by no means follows that the whole of these rock-masses are of Archæan age. Nicol always held that among the complicated foldings of the Highland rocks many portions of the older Palæozoic formations, in a highly-altered condition, were included. The same view has been persistently maintained by Dr. Hicks, to whose researches among the more ancient rock-masses of the British Isles geologists are so greatly indebted, and also by Professor Lapworth. To the settlement of this very important question we may feel sure the effort of the officers of the Geological Survey will be especially directed.

The geological surveyors of Scandinavia have been so fortunate as to detect, in rocks of an extremely altered character, a number of fossils sufficiently well preserved for generic, and sometimes even for specific, identification. Failing the occurrence of such a fortunate accident, I confess that it has always appeared to me that the disturbances to which these Highland rocks have been subjected are so extreme, and the difficulty of making out the original planes of bedding so great, that but little can be hoped for from general sections constructed to show the relations of the rocks of the Central and Southern Grampians to the fossiliferous deposits of the north-west of Sutherland.

Since the last meeting of the British Association in the Highlands, much progress has been made in the study of that pre-eminently British formation—the old red sandstone. Dr. Archibald Geikie has thrown much new light, by his valuable researches, on the relations of the several members of the vast series of deposits which go by that name; while Dr. Traquair, bringing to bear on the subject great anatomical knowledge, has re-examined the collections of fossil fish made by that indefatigable explorer, Hugh Miller. The old red sandstone is the only system of strata which we possess, while it is either wholly absent or very imperfectly represented in Scandinavia.

In the year 1876 I was able to announce that a vestige —a small but highly interesting vestige—of the great carboniferous system existed within the limits of the Scottish Highlands. Overwhelmed by successive lava-streams that were piled upon one another to the depth of many hundreds of feet, and then carried down by a fault which buried it at least 2,000 ft. in the bowels of the earth, this fragment has remained while every other trace of the formation has been swept from the Highlands by the besom of denudation.

Down to post-glacial times Scotland and what were now its outlying islands remained united with Scandinavia. I need not remind you how during the glacial period they were the scene of a similar succession of events, while from their then far more elevated mountain-summits streams of glacier ice flowed down and relieved the mantle of snow which enveloped them. But at a very recent geological period—and indeed since the appearance of man in this part of our globe—the separation of the two areas, so long united, was brought about.

In the district now constituting the North Sea, which separates the two countries, great faults, originating in the Tertiary epoch, appear to have let down wide tracts of the softer Secondary strata among the harder crystalline rock masses. The numerous changes of level, of which we find such abundant evidence around the shores of this sea, facilitated the wearing away of the whole of these softer secondary deposits, except the slight fringes that remained along the shores of Sutherland, Ross, and Cromarty, on the one hand, and the isolated patches forming Scania, Jutland, and the surrounding islands on the other. Little could the Vikings, as they sailed over this shallow sea, have imagined that their predecessors in these regions were able to roam on foot from Norroway to Suderey.

It is almost impossible to over-estimate the effects produced by the several denudations to which Scandinavia and the Scottish Highlands have been successively subjected. In that which occurred during the later Tertiary periods, almost every portion of the non-crystalline rocks that rose above the sea level was either entirely removed or converted into level plains, which, covered with drift deposits, now form districts like Scania and Denmark. Whereas in the great central valley of Scotland hard volcanic masses are associated with the softer sedimentary rocks, the former are left rising as picturesque crags, standing boldly up above the general level, while the latter are worn down and buried under drift. In the west of Scotland a chain of volcanic mountains, with summits towering to the height of from ten to fifteen thousand feet, have been reduced by this same denudation to basal wrecks, the highest portions of which attain to but little more than 3,000 ft. above the sea level.

During the great elevation and denudation which marked the Neocomian period thousands of feet of strata must have been removed over wide areas, as is proved by the wonderful overlap of the cretaceous beds on all the old strata. Of the enormous sub-aërial waste which went on in these Northern Alps during the newer Palæozoic periods we have impressive evidence in the vast masses of the old red sandstone and carboniferous rocks—themselves only a series of fragments that had survived the later denudations—for these rocks were built up of the materials derived from our Northern Alps. The Torridon sandstone is the monument—and a very striking monument too—of another and still earlier period of enormous denudation. The thousands of feet of conglomerate and sandstone of which it is made up consist of the disintegrated crystals of granites and gneisses that have been swept away.

When we penetrate towards the axis of this eroded mountain chain the proofs of the magnitude of these denudations become even more strking and impressive. Here we see towering aloft the ruined buttresses of vast rocky arches that when complete must have risen miles above the present surface: there we find lying side by side rock masses that could only have been brought together by displacements of tens of thousands of feet; yet so complete has been the planing down of the surface

since, that it requires the most careful study even to detect the almost obliterated traces of these grand movements.

The Alps and the Himalayas during their elevation have suffered enormous waste and denudation; but if the elevation were to cease and the waste to go on till these magnificent mountain chains were reduced to masses of diminutive peaks, ranging from 2,000 ft. to 8,000 ft. in height, we should then have the counterpart of this stupendous ruin of the mountain chain of the north.

The history of the series of successive movements to which the rock masses of our Highlands has been subjected is one well worthy of the most attentive study. When the evidence bearing upon the subject is carefully sifted and weighed we become convinced of the fact that many of these movements—including some on a prodigious scale—must have taken place during what we are commonly accustomed to regard as comparatively recent geological periods. On the eastern coast of Sutherland a mass of secondary rocks, including several thousands of feet of triassic, rhætic, and jurassic strata, have been let down by a gigantic fault, so as to be placed in juxtaposition with the old red sandstone and the crystalline rocks. Now, taking the very lowest estimates of the thicknesses of the several strata affected, the vertical "throw" of this fault must have exceeded a mile. It may not improbably, indeed, have been at least double or treble that amount. Yet this great dislocation was certainly produced at a later date than the upper Jurassic period, for rocks of that age are found to be affected by it.

Along the coasts of the Black Isle strata of middle and upper Jurassic age are similarly found faulted against the "old red" and the crystalline rocks. On the other side of the North Sea, in Ando, one of the Lofoden Isles, a patch of lower oolite strata, consisting of marine and estuarine strata, and including beds of coal like that of Brora, is found let down by gigantic faults into the very heart of the crystalline rocks of the district. In Scania the whole of the secondary rock masses owe their preservation in the same way to a plexus of tremendous faults, by which they have been entangled among the harder rocks. Those faults have affected not only the Jurassic strata, but even the very youngest members of the cretaceous series.

Nor are we without evidence that some of the great faults are of post-cretaceous age in this country, for in the Western Highlands displacements of several thousands of feet have been detected which affect not only the upper cretaceous, but also the older Tertiary rocks.

The effects produced by these great dislocations, which had a generally parallel direction in our Highlands from north-east to south-west, are of the most startling character. Great strips of triassic and old red sandstone strata, like those of Elgin and Turriff and Tomintoul, and of the line of the Caledonian Canal, are found let down among the crystalline rocks by these gigantic faults. The great central valley of Scotland itself consists of masses of newer Palæozoic strata, faulted down between the harder Archæan and lower Palæozoic rocks, which form the Highlands on the one hand, and the border land on the other. That many of the stupendous earth movements which produced the foliation of the rocks of Scandinavia and the Scottish Highlands must be referred to Archæan times there is not the smallest room for doubt. That similar effects have resulted from the same agencies during subsequent periods our fellow geologists in Scandinavia believe they have found incontrovertible proof. For my own part, I look forward confidently to the establishment of the same conclusion from the study of our own Highland rocks.

THE YOUNG ELECTRICIAN.

By W. Slingo.

(*Continued from p.* 199.)

Ex. CVIII. Fig. 61 illustrates a form of electroscope which may be very easily and cheaply made. The glass shade may consist of any ordinary bottomless unstoppered gas jar having a diameter of three or more inches, and a height of six inches or thereabouts. Jars of this kind are, comparatively speaking, dear, but the expenditure is not at all necessary, more especially if it is preferred to put one's self to a little trouble in order to save expense. The jar may be readily obtained by cutting down an ordinary clear glass bottle, such a one as spirits, &c., are often sold in. The cutting presents no serious difficulty if a little care is taken. Suppose A B, Fig. 62, to be the bottle. The neck usually bulges a little, as at C D. This is perhaps an advantage, for if the neck is a long one, we can cut it at C D, and the conical neck resulting will assist in fixing the stopper. Tie *as tightly as possible* pieces of fine twine round the neck at C D, and round the bottom of the bottle at E F. Then revolve the bottle in the flame of a spirit lamp so as to char in turn each piece of twine without setting fire to it. It will be found possible, after a few revolutions, to divide the glass by tolerable clear cuts under the twine, a gentle tap being applied now and then as the heating progresses.

A similar process, answering as well if not better, is to soak a piece of knitting-cotton or worsted in paraffin oil, tie it somewhat tightly to the bottle and then set fire to it. The bottle should be held horizontally, and protected from any considerable draught, so as to confine the flame as nearly as possible to the line of the cotton. After allowing the oil to burn nearly out, plunge the bottle in a basin of cold water as far as the cotton, when the neck or bottom, as the case may be, will fall off, leaving a tolerably clean cut.

These are plans which I have rarely found to fail, and have used them on several kinds of glass. Crosse & Blackwell's wide-mouthed pickle-bottles answer famously, and would be recommended for this purpose, were it not that the glass is somewhat too green. If the cut edges of the glass are exceptionally rough or uneven they may be filed down with a smooth or second-cut file, applying the tool gently. If a bastard (or coarse) file is used, or if too much pressure is applied, there is great danger of chipping off more than is desired. When tolerably even, the edges may be made as smooth as desired by grinding down on medium emery-cloth moistened with turpentine.

The jar being made, the next step is to fit the stopper (D Fig. 61). This may be an indiarubber cork (this is suggestive of an "iron milestone," by the way) or stopper. Such an article answers admirably, but it is expensive. Let us use either a good sound cork or, equally well if not better, a piece of dry wood—mahogany will do nicely. If there is any doubt about its dryness, place in a warm oven for a short time. Then cut it to shape and bore a hole through the centre (longitudinally) a quarter of an inch in diameter. Next immerse it in melted paraffin wax, until it is as thoroughly saturated as possible: this will prevent the subsequent entrance of moisture. Leaving this to soak, let us next cut off two

strips of tinfoil five inches long and an inch wide. Cover one face of each for four inches of its length with flour paste and therewith attach them to the inner surface of the jar, placing them four inches up the glass and as nearly as possible opposite each other or at the extremities of a single diameter, and leaving an inch of foil in each case free. Subsequently bend these free ends over the bottom edge and paste on the outside of the glass. Then procure a piece of copper, brass, or even iron wire, of any convenient thickness, pass it round the outside of the jar three-quarters of an inch from the bottom, twist the two ends tightly together (so as to prevent subsequent slipping), and bend the twisted ends in a hook as at C (Fig. 61). This hook affords a means of attachment for a light chain, wire or any other substance which may be used for an earth connection. The wire should make electrical contact with the tin-foil strips.

To return to the stopper. The hole is usually fitted with a piece of glass tubing, through which the metal wire W W is passed and held in position by binding it round with sufficient silk ribbon to make a tight fit; but I scarcely think this is necessary, more particularly if the instrument is kept clean and free from dust. Let us simply use a piece of wire or rod six inches long, and fitting friction-tight into the hole in the wood. This is thicker than is really

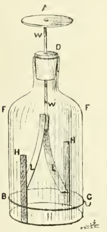

Fig. 61.

Fig. 62.

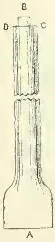

Fig. 63.

necessary, a much thinner piece of wire answering in most cases equally well; but the cost would not be more than a penny, and it would allow us to place a moderately heavy body on the plate A without any fear of the whole thing collapsing. After seeing to the fit remove it from the wood, and with a second-cut file work a small length (an eighth of an inch) down to about half the original diameter—that is, to an eighth of an inch. This may be done by securing the rod in a small hand-vice (Ex. XXVIII) which is placed in the left hand. Then, laying the end of the rod on the table, pass the file (held in the right hand) over it, turning it at the same time towards the file. At the same time an even shoulder C D, Fig. 63, should be formed. Next hammer down the end A to about the shape shown, making the extreme edge not less than half-an-inch wide. If the rod is of iron it will require to be made red-hot before it is hammered down.

The plate A, Fig. 61, may be cut from tinned iron, but, of course, brass looks nicer, is more substantial, and will fit better on to the rod. Cut a piece of metal (say a thirty-second of an inch thick) as nearly circular as possible, making the diameter 3 or $3\frac{1}{2}$ in. Use a smooth file for finishing-off, and avoid leaving any points or other projections. Drill through the centre (Ex. XXIX. to XXXV.) a hole an eighth of an inch in diameter. Through this, pass the reduced end B of the rod A B, Fig. 63, and rivet together by hammering out the projecting portion B. See that A rests fairly on the shoulder C D, so as to avoid any danger of the plate tilting over at any time. If it is necessary—that is, if sufficient rigidity is not obtained, the two may be soldered together. (Ex. XI. to XIV.) Before fitting the plate, the rod must be passed through the wooden stopper again.

The next thing is to attach the leaves L L. These may be of Dutch metal, of which a whole book may be purchased for a few pence. Place a leaf (lifting it with the point of a clean knife-blade) between two pieces of note-paper, lay on a board, and cut two strips 3 in. or so long and $\frac{1}{2}$ in. wide. Remove carefully the upper strips of paper, and, having already gummed the two flat faces on A (Fig. 63), lay one on the end of one of the metal strips, raise cleanly and carefully, and place the other face on one end of the other metal strip. If properly done the two leaves or strips will hang evenly and parallel. Above all, draughts should be avoided, and the fingers should be kept from coming into contact with the leaves. If any accident happens it is useless attempting to put matters right. The only resource is to cut another strip, or two if need be.

When the strips are in position, hold the rod vertically, pass the lower portion together with the strips into the jar, and fix the stopper, D, into the neck. Let W W (that is A B, Fig. 63), remain about 3 inches above the stopper. Then having prepared some sealing-wax or shellac varnish, brush a little over the stopper, sealing up any space that may be left in the central hole through which the rod passes, or any interstices that may present themselves between the stopper and the glass. A little ordinary sealing-wax may be used in the ordinary way with perhaps equal advantage, but it does not always look so neat as might be desired.

The young electrician will now be provided with a very efficient instrument, and I think it may fairly be said that the cost of the parts does not exceeded threepence, especially if only an iron rod and a tinned iron plate are used. Sometimes I have been driven into a hole for want of an electroscope. I have then extemporised one for the occasion with very satisfactory results; but of this a few words next time.

SCRAPS FROM THE BRITISH ASSOCIATION.

Though the accumulation of facts is indispensable to the growth of science, a thousand facts are of less value to human progress than is a single one when it is scientifically comprehended, for it then becomes generalised in all similar cases. Isolated facts may be viewed as the dust of science. The dust which floats in the atmosphere is to the common observer mere incoherent matter in a wrong place, while to the man of science it is all important when the rays of heat and light act upon its floating particles. It is by them that clouds and rains are influenced; it is by their selective influence on the solar waves that the blue of the heavens and the beauteous colours of the sky glorify all nature. So, also, ascertained through isolated facts, forming the

dust of science, become the reflecting media of the light of knowledge, and cause all nature to assume a new aspect. It is with the light of knowledge that we are enabled to question nature through direct experiment. The hypothesis or theory which induces us to put the experimental question may be right or wrong; still, *prudens quæstio dimidium scientiæ est*—it is half way to knowledge when you know what you have to inquire. Davy described hypothesis as the mere scaffolding of science, useful to build up true knowledge, but capable of being put up or taken down at pleasure. Undoubtedly a theory is only temporary, and the reason is, as Bacon has said, that the man of science "loveth truth more than his theory." The changing theories which the world despises are the leaves of the tree of science, drawing nutriment to the parent stems, and enabling it to put forth new branches and to produce fruit; and though the leaves fall and decay, the very products of decay nourish the roots of the tree, and reappear in the new leaves or theories which succeed—*Sir L. Playfair.*

The coal which has hitherto been the chief source of power probably represents the product of five or six million years during which the sun shone upon the plants of the carboniferous period, and stored up its energy in this convenient form. But we are using this conserved force wastefully and prodigally; for, although horse-power in steam engines has so largely increased since 1864, two men only now produce what three men did at that date. It is only 300 years since we became a manufacturing country. According to Professor Dewar, in less than 200 years more the coal of this country will be wholly exhausted, and in half that time will be difficult to procure. Our not very distant descendants will have to face the problem—What will be the condition of England without coal? The answer to that question depends upon the intellectual development of the nation at that time. The value of the intellectual factor of production is continually increasing; while the values of raw material and fuel are lessening factors.—*Sir L. Playfair.*

Few would ask now, as was constantly done a few years ago, "What is the use of an abstract discovery in science?" Faraday once answered this question by another, "What is the use of a baby?" Yet round that baby centre all the hopes and sentiments of his parents, and even the interests of the State, which interferes in its upbringing so as to ensure it being a capable citizen. *Sir L. Playfair.*

Let me take a single example of how even a petty manufacture improved by the teachings of science affects the comforts and enlarges the resources of mankind. When I was a boy, the only way of obtaining a light was by the tinder-box, with its quadruple materials, flint and steel, burnt rags or tinder, and a sulphur match. If everything went well, if the box could be found and the air was dry, a light could be obtained in two minutes; but very often the time occupied was much longer, and the process became a great trial to the serenity of temper. The consequence of this was that a fire or a burning lamp was kept alight through the day. Old Gerard, in his herbal, tells us how certain fungi were used to carry fire from one part of the country to the other. The tinder-box long held its position as a great discovery in the arts. The *pyxidicula igniaria* of the Romans appears to have been much the same implement, though a little ruder than the flint and steel which Philip the Good put into the collar of the Golden Fleece in 1429, as the representation of high knowledge in the progress of the arts. It continued to prevail till 1833, when phosphorus matches were introduced, though I have been amused to find that there are a few venerable ancients in London who still stick to the tinder-box, and for whom a few shops keep a small supply. Phosphorus was no new discovery, for it had been obtained by an Arabian called Bechel in the eighth century. However, it was forgotten, and was rediscovered by Brandt, who made it out of very stinking materials in 1669. Other discoveries had, however, to be made before it could be used for lucifer-matches. The science of combustion was only developed on the discovery of oxygen a century later. Time had to elapse before chemical analysis showed the kind of bodies which could be added to phosphorus so as to make it ignite readily. So it was not till 1833 that matches became a partial success. Intolerably bad they then were, dangerously inflammable, horribly poisonous to the makers, and injurious to the lungs of the consumers. It required another discovery by Schrötter in 1845 to change poisonous waxy into innocuous red-brick phosphorus in order that these defects might be remedied, and to give us the safety-match of the present day.—*Sir L. Playfair.*

The true cultivators of the tree of science must seek their own reward by seeing it flourish, and let others devote their attention to the possible practical advantages which may result from their labours. There is, however, one intimate connection between science and industry which I hope will be more intimate as scientific education becomes more prevalent in our schools and universities. Abstract science depends on the support of men of leisure, either themselves possessing, or having provided for them, the means of living without entering into the pursuits of active industry. The pursuit of science requires a superfluity of wealth in a community beyond the needs of ordinary life. Such superfluity is also necessary for art, though a picture or a statue is a saleable commodity, while an abstract discovery in science has no immediate or, as regards the discoverer, proximate commercial value. In Greece, when philosophical and scientific speculation was at its highest point, and when education was conducted in its own vernacular and not through dead languages, science, industry, and commerce were actively prosperous. Corinth carried on the manufactures of Birmingham and Sheffield, while Athens combined those of Leeds, Staffordshire, and London, for it had woollen manufactures, potteries, gold and silver work, as well as shipbuilding. Their philosophers were the sons of burghers, and sometimes carried on the trades of their fathers. Thales was a travelling oil merchant, who brought back science as well as oil from Egypt. Solon and his great descendant Plato, as well as Zeno, were men of commerce. Socrates was a stonemason; Thucydides a gold-miner; Aristotle kept a druggist's shop until Alexander endowed him with the wealth of Asia. All but Socrates had a superfluity of wealth, and he was supported by that of others.—*Sir L. Playfair.*

Science has in the last hundred years altered altogether the old conditions of industrial competition. She has taught the rigid metals to convey and record our thoughts even to the most distant lands, and, within less limits, to reproduce our speech. This marvellous application of electricity has diminished the cares and responsibilities

of Governments, while it has at the same time altered the whole practice of commerce. To England steam and electricity have been of incalculable advantage. The ocean, which once made the country insular and isolated, is now the very life-blood of England and of the greater England beyond the seas. As in the human body the blood bathes all its parts, and through its travelling corpuscles carries force to all its members, so, in the body politic of England and its pelagic extensions, steam has become the circulatory and electricity the nervous system. The colonies, being young countries, value their raw materials as their chief sources of wealth. When they become older they will discover it is not in these, but in the culture of scientific intellect, that their future prosperity depends. Older nations recognise this as the law of progress more than we do; or, as Jules Simon tersely puts it, "That nation which most educates her people will become the greatest nation; if not to-day, certainly to-morrow."—*Sir L. Playfair.*

No great discovery flashes upon the world at once, and, therefore, Pope's lines on Newton are only a poetic fancy—

"Nature and Nature's laws lay hid in night,
God said, 'Let Newton be,' and all was light."

No doubt the road upon which he travelled had been long in preparation by other men. The exact observations of Tycho Brahe, coupled with the discoveries of Copernicus, Kepler, and Galileo, had already broken down the authority of Aristotle and weakened that of the Church. But, though the conceptions of the universe were thus broadened, mankind had not yet rid themselves of the idea that the powers of the universe were still regulated by spirits or special providences. Even Kepler moved the planets by spirits, and it took some time to knock these celestial steersmen on the head. Descartes, who really did so much by his writings to force the conclusion that the planetary movements should be dealt with as an ordinary problem in mechanics, looked upon the universe as a machine, the wheels of which were kept in motion by the unceasing exercise of a divine power. Yet such theories were only an attempt to regulate the universe by celestial intelligences like our own, and by standards within our reach. It required the discovery of an all-pervading law, universal throughout all space, to enlarge the thoughts of men, and one which, while it widened the conceptions of the universe, reduced the earth and solar system to true dimensions. It is by the investigation of the finite on all sides that we obtain a higher conception of the infinite—

"Willst du ins Unendliche schreiten,
Geh nur im Endlichen nach allen Seiten."

—*Sir L. Playfair.*

Navigation and commerce mightily benefited by our better knowledge of the motions of the heavenly bodies. Still, these benefits to humanity are incomparably less in the history of progress than the expansion of the human intellect which followed the withdrawal of the cramps that confined it. Truth was now able to discard authority, and marched forward without hindrance. Before this point was reached Bruno had been burned, Galileo had abjured, and both Copernicus and Descartes had kept back their writings for fear of offending the Church. The recent acceptance of evolution in biology has had a like effect in producing a far profounder intellectual change in human thought than any mere impulse of industrial development. Already its application to sociology and education is recognised, but that is of less import to human progress than the broadening of our views of Nature. Abstract discovery in science is, then, the true foundation upon which the superstructure of modern civilisation is built; and the man who would take part in it should study science, and, if he can, advance it for its own sake and not for its applications. Ignorance may walk in the path lighted by advancing knowledge, but she is unable to follow when science passes her, for, like the foolish virgin, she has no oil in her lamp. An established truth in science is like the constitution of an atom in matter—something so fixed in the order of things that it has become independent of further dangers in the struggle for existence. The sum of such truths forms the intellectual treasure which descends to each generation in hereditary succession. Though the discoverer of a new truth is a benefactor to humanity, he can give little to futurity in comparison with the wealth of knowledge which he inherited from the past. We, in our generation, should appreciate and use our great possessions—

"For me your tributary stores combine,
Creation's heir; the world, the world is mine."

—*Sir L. Playfair.*

Mr. Buchan, secretary of the Meteorological Society of Scotland, read a paper on the rainfall of the British Islands, in which he gave the results of observations during the twenty-four years from 1860 to 1883, at 1,080 stations in England and Wales, 547 in Scotland, and 213 in Ireland; in all 1,840. The regions of heaviest rainfall marked off by an average of 80 in. or upwards annually were four—Skye and a large portion of the mainland to the south-east as far as Luss, on Loch Lomond, the greater part of the Lake district, a long strip including the more mountainous part of North Wales and the mountainous district in the south-east of Wales. The West Highlands presented the most extensive region of heaviest rainfall in the British Islands. The heaviest rainfall in Scotland, 128·50 in., was at Glencroe. On the other hand, the smallest rainfall, varying from 22·50 in. to 25 in., overspread a large section of the south-east of England from the Humber to the estuary of the Thames, excluding the higher grounds of Lincoln and Norfolk, and including a small patch in the valley of the Thames from Kew to Marlow.

Mr. J. Wilson Swan read a paper on an electric safety-lamp for miners, in which he submitted the latest result of an attempt to adapt electric lighting to the requirements of coal-mining. He said it was more than doubtful if any of the lamps at present in use were safe in an explosive atmosphere in a state of abnormally rapid motion, or when subject to a rush of air, such as a blast or the accidental swing of a lamp might occasion. The fragile partition of wire gauze, which alone presented a barrier to the passage of flame from the lighted wick inside the lamp to an explosive mixture of gas outside, was too slight a defence against the danger of explosion. The lamp which he submitted for examination was protected by a very thick glass bull's eye, light being economised by a silvered reflector behind the lamp. Two sockets within the case provided the means of connecting the battery terminals with the charging circuit. The combined apparatus of battery and lamp weighed 6¾ lb., and the cylindrical case containing the cells measured 8 in. by 4 in. Mr. Swan claimed for the new lamp that it possessed the merit of being absolutely safe. If it was neither so light nor so cheap as the ordinary lamp, it was in both respects at least practicable, and especially was it to be noted that the working cost would probably not be more than that of the ordinary lamps. As regarded the

weight, he was not without hope of being able to reduce it. The lamp did not, like others now in use, indicate the presence of fire-damp.

Mr. James N. Shoolbred gave some facts bearing upon the electric lighting of the Forth-bridge works. The electrical plant employed in the lighting of the works consisted, he stated, of thirteen dynamo machines, 100 large arc lamps of 2,000 candles each, 500 incandescent lamps of 200 candles, and about twelve miles of mains. Among the many interesting operations which had occurred was the lighting of the deep-water caissons for the main piers, in some cases from 70 ft. to 80 ft. under water. Those at South Queensferry were lit by incandescent lights, while at Inchgarvie, owing to blasting operations being necessary, arc lamps were employed. The firing of the blasting charges was also performed from the same dynamo which was providing the lighting.

Gossip.

By Richard A. Proctor.

From all sides we receive promise of good support for Knowledge in the monthly form. The weekly Knowledge will continue till October 16th, on which day the last number of the old series will appear. The first number of the new series will bear date November 1st, and be called the November number of Knowledge, *a Monthly Illustrated Magazine of Science, Literature, and Art*. Science will as heretofore be our chief subject; but we wish to be free to introduce Literary and Artistic matter when occasion may arise, without seeming, as at present, to act inconsistently with our announced purpose.

During the next four weeks our plans in detail for the new series will be fully indicated.

A letter by "Kolokol," in this week's issue, touches on a question of some interest. It does seem a pity that musical power should be so often wasted for want of fingering skill, or some other matter of *technique*. Of two musicians one shall have the true musical faculty, the power of bringing out the real thought and meaning of a great composer, but so little manual dexterity—for want of time and opportunity for practice, that he shall be unable to produce music worth listening to, when he attempts anything at all difficult; the other shall possess marvellous skill in execution, the result of thousands of hours of practice, yet wanting the soul of music his performance shall be far better worth watching than worth being listened to. The number of those who play skilfully is great, the number of those who if they had manual skill could play movingly, is considerable. But those who combine both qualities—and both are absolutely needed, as musical instruments are at present constructed—are few and far between. To one who like myself may not have an hour per month for musical practice, the trouble touched on by "Kolokol" is trying. I am not thinking of music as preposterously employed for display. The "little bit of music" asked for at social gatherings is generally a great nuisance with little music in it indeed. But to those whose work engrosses their attention closely while they are engaged on it, music—if they love music—would be a great aid were not the necessary skill so difficult to acquire and retain. I would certainly be willing to pay a long price if I could have, without incessant practice, the power of rendering such music as I love, in such a way as would correspond with my own idea of its meaning. I do not want to hear some one else play, still less to have an automatic rendering of the piece I love; nor do I want to play it for others to hear; I simply long to dwell on its melody, to enjoy its harmonies, to feel the emotions to which it appeals. And I want to do this at some moment of weariness or anxiety,—not to put off the matter to such and such an evening when,—in evening suit, in a gassy atmosphere, and in the glare of too much light,—I may hear Von Bulow, or Rubinstein, or some other performer, render that music to the accompaniment perhaps of chattering fan-flipping idiots who go to musical entertainments because it is the fashion, and have taken, unfortunately, some neighbouring seats.

But however one may love music or in particular some special movement, one may be utterly unable to render it. A few lines, and some awkward passage comes,—one stumbles—and ere many minutes are over all power of enjoying the piece passes away.

We do not get from music one-hundredth part of what music might do, even as it is,—even with instruments requiring more practice than most men can afford to give. We use music, indeed, oftener for torture and annoyance than for pleasure. Nine out of ten of those whose music we have to hear have learned how to play with considerable dexterity—or ambidexterity—but have no more idea of rendering the conceptions of the great composers than they have of angelic flying.

Speaking of angels, I want to know why I was seized the other day with a fit of shouting-laughter, at the sight of a very lovely angel, with the conventionally graceful though impossible wings, the usual evidence of excellent diet, the customary Greekish costume, and differing only from other angels in *wearing boots*. They were very nice boots, fur-lined and slightly Balmoralish in shape (I could not see if they were fashionably high-heeled): but why should I be compelled to laugh consumedly at an angel in boots, more than at Guido's angels with violins and triangles? There are many angels in braces,—at Pugin's Catholic Church in Clapham the angels have really excellent braces,—and braces seem as funny for an angel as boots, if not funnier. Yet I have refrained even from smiling at the braced angels, while the Balmorally-booted angel overcame me at once. I find nothing in Herbert Spencer's "Philosophy of Laughter" to explain this.

I do not know how angels' boots are fitted. Most of the wingless angels on earth have boots not fitted at all—and one would gladly hear that schools of art were teaching these angels the proper shape of feet, and the superiority of walking over tottering. But Mr. W. M. Williams has certainly described the only proper way to get shoemakers to fit one with comfortable boots. I am not so much adopting his idea as commending it, on the *experte-credo* principle. I wear always a thin sock over a thick one, or even two thin ones, when I go to be measured for boots. For the average shoemaker seems to think himself bound to pinch you, and then to repeat that standing lie, "They will soon wear easy, Sir." Most assuredly that is a proposition of which one may say *Solvitur ambulando*: it is resolved into the falsehood it is, when you try walking. (This is an entirely new rendering.)

Miss Ballin, in commenting on the mistake I made in substituting the sun for the earth, when dealing with the question of the ruddy solar eclipse, tells of a remarkable case in which Trousseau, after carefully weighing the question whether he would or would not give a patient belladonna, as usual, for a particular ailment, and determining that he would *not*, nevertheless wrote out the usual prescription and gave it to the patient in perfect unconsciousness that he was not carrying out his purpose.

One of the oddest cases of the kind which has ever occurred to me in literary work happened when I was correcting one of the earliest sheets of my first book—"Saturn and its System." I was describing Kepler's discovery of his third law, as illustrated by the periods and distances of Saturn and the Earth. After representing the distance and period of the earth, both, by unity, and so getting two numbers, one representing the distance the other the period of Saturn, I went on to consider the power of these numbers as follows,—"The first is less than the second, but the square of the first is greater than the second; let us then try the square of the second;—the square of the first is less than the square of the second, but the next or third power of the first is equal to the square of the second: here then is the law we are seeking" or words to that effect. All this was correctly printed. Reading a review of the book in the *Quarterly Journal of Science*, I found the author of the review asking what I could possibly mean by saying of the above-named numbers "The first is less than the second; but the square of the first is greater than the square of the second,"—which is obviously unmitigated nonsense (or as a friend described an article of mine the other day, "unparalleled rot"). I turned to the passage, and there was the preposterous statement. Now in those days, being but a beginner, I had kept the proofs and revises of my book with exemplary care. I turned therefore to these. And I found this startling thing:—I had deliberately corrected the first proof, in which the matter had been quite correctly stated, into the absurdity criticised. If I had originally written that nonsense, and passed it in proof and revise, I should not have wondered,—or at any rate I should not now wonder, knowing what can be done in that way. But to take the correct statement and deliberately alter it into nonsense, was surely a strange thing for the abstracted mind to do.

In my "Transits of Venus" I wrote, and corrected in proofs and double revises, "seconds" for "minutes," throughout ten or twelve pages, in regard to the most important time-elements in the whole problem of determining the sun's distance from transit observations,—viz., the difference of duration of the transit for the Halleyan method, and the difference in the times of beginning and ending for the Delislean.

Professor Kaiser of Leyden dealing with the rotation-period of Mars with exceptional care, and considering every detail, even to some not capable of affecting the result by the one thousandth of a second, made two gross mistakes, affecting the result by a full tenth of a second. I have myself, frequently, while differentiating and integrating like harlequin, without a slip, made mistake in multiplication and division that a child would be ashamed of. I was once two hours bringing two calculations into agreement, through a mistake in dividing by *two*.

"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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No communications are answered by post, even though stamped and directed envelope be enclosed.

PRACTICAL WORK FOR SCIENCE—STAMMERING—INSTRUMENTAL MUSIC.

[1925]—You open your columns to all comers who have anything to say bearing on practical matters. Permit me a word. First, as regards stammering. There are advertisements to be met frequently from persons who undertake to cure stammering. But let any one go to these and say, "I wished to be cured, name your price, to be paid on completion of cure. I will deposit the money with some trustworthy person. I am most anxious to be cured, and will follow minutely all your directions," what will the answer be? Hemming and hawing, and shuffling. Stammering is greatly on the increase. Why will not scientific men take the matter in hand? Any man who could *really* cure this disease would be able to retire in a few years with a large fortune. I know several men, to whom money is no object, who would give large sums to be cured of stammering; but, then, it must be a cure. Second, as regards instrumental music, many men, having had neither time nor opportunity in their youth to study music, are anxious, as leisure comes to them, to shine later in life—say from twenty-five to forty-five—to play some instrument. They begin to practise, but the hand does not answer the brain. The theory is easily acquired, but the joints and ligaments of the fingers, hand, and wrist are stiff and disobedient. Is it impossible to bring scientific aid to bear here? I have been told that eight hours' a day practice for ten years would produce the required result; what we want is an hour or an hour-and-a-half for a twelvemonth to enable us to join in a quartett or symphony party. Flexibility of finger and strength of muscle must be obtained; if this can be assisted by science, the rest is easy. I have taken Knowledge from the beginning, and have seven handsome volumes on my shelf of interesting and useful matter. I will miss greatly the weekly issue; but I hope the monthly one will be as successful as its predecessor. Kolokol.

THE OCULAR SPECTRA.

[1926]—It will be quite evident to anyone who is not preoccupied with his own notions, and who may have carefully read my letters on the Ocular Spectra—a class of phenomena I have so long and carefully observed, a class of phenomena on which, as I have shown, the ultimate science of chromatics must be founded—that my expression, "no external existence whatever" meant simply, that these spectra are not copies of images external to our own being, as is taught in most works on colour, but that they are merely phenomena of our inner consciousness, of which it is impossible to determine the precise seat. When touching upon the origin of these spectra in my several letters, I have attributed them to re-actions in the optic sense caused by some strong primal excitation from without, so that there is not the slightest ground for imputing to me the denial of external causation. I do not deny externality to these causes, but to the optical effects of these causes—two very different things. No letter of mine was specially penned as a reply to any remarks made by Mr. Alexander; my purpose was to carry out a complete exposition of the phenomena from observation and knowledge. I merely touched *en passant* on his rather abrupt and unwarranted expression of surprise. W. Cave Thomas.

A SHOWER OF SNAILS.

[1927]—It may be interesting to some of your readers to know that, during a downpour of rain on Thursday, 3rd inst., a very thick shower of small snails fell with it, in Pembroke Dockyard. They

literally covered the ground in a space of about one hundred yards' diameter. They were all about the same size. Most of them were alive and creeping about for a couple of days after they fell.

B. Reynolds.

OCEAN TELEGRAPHY.

[1928]—In your last number, under "Gossip," you invite evidence on the trustworthiness of transatlantic telegraphy. I take pleasure in giving you the following facts:—

The firm I serve is almost daily in communication with New York, Charleston, S.C., and Memphis, Tenn. (probably a very good reason why our messages arrive so punctually and correctly). We pass messages in English, French, Latin, and Spanish severally. Our cables often consist of thirty to forty words, and are almost invariably correct transmissions, to a letter. Errors, of course, do occur, but, my impression is, through illegible writing on the sender's part more often than from carelessless on the part of the cable officials.

As a rule, our transatlantic friends dispatch their messages at the close of their business—6 to 7 o'clock, and the same are usually to hand on the following morning.

I think I see a moral in your conductor's experience. In future, despatch messages from the local head office only.

I take this opportunity of expressing my regret that Knowledge in future is to be a monthly publication, as I shall be a loser (intellectually); but I trust it will receive the success it deserves.

O. R.

THOUGHT TRANSMISSION.

[1929]—During the year 1872 or 3, when a law student in London, I saw in one of the V. C. Courts an elderly Q.C. who was partially paralysed, and who made mems. with his left hand. A Chancery clerk whispered his name to me, and remarked that he did a larger business in that Court than any other Q.C., and that he had "all the brains of the bar." I thought no more of him until Thursday morning last, when I woke about 7.30 and, to my surprise, found I was thinking about this particular barrister, whose name I could not recollect. I see in the *Standard* of to-day that a Mr. Southgate, Q.C., died on that day, and, if I am not mistaken, that was the name of the gentleman. If I am wrong, this letter is only good for the waste-paper basket, but if I am correct in thinking that Mr. S. was paralysed, and wrote with his left hand, I consider it quite as interesting a coincidence as that described in "R. T. C.'s" letter (1912) on "Thought Transmission," which I have just been reading, and I should much like to know at what hour Mr. S. died.

M.A., S.S.C.

MENTAL DEVELOPMENT.

[1930].—According to "Hallyards," in Knowledge, No. 1891, we Europeans are "but a compost" (we should have preferred some other term, for this word savours of the stable-yard), "of Italian, Celtic, and German savages of old," he does not tell us whence they came, "these savages of old," or whether they were like Topsy, who "guessed she grow'd."

If we look back into the history of the world, or, further still, to pre-historic times, we shall be able to trace the rise, growth, and decadence of various ornamental arts on our continent.

Many reasons might probably be advanced for the gradual decadence of art in Europe, and the deterioration in certain manuactures, but we will only touch upon one or two of the most prominent and likely ones.

It seems a very general rule, that as soon as any European nation attains a high degree of civilisation they become intensely progressive in their ideas, things begin to go at railway speed, articles are turned out to please the million, the declension of art is inevitable, the goldsmith's work, sculptures carpets, &c., are turned out to pattern or to order instead of being, like the paintings of Fra Angelico or the metal-work of Benvenuto Cellini, a creation of the artist soul, not executed for the praise of men, but because their art was a part of their life; such men were not the mere human machines which they necessarily become under the conditions of the nineteenth century, in which the increasing demand is for novelty, not quality. Many articles which in former times were only within reach of the few are now obtainable at a small cost in money; but how inferior in quality!

The tendency to imitation, and that not of the best kind, causes inferior materials to be used; the thing made may have some likeness to the original, but the same amount of labour and thought has not been bestowed upon it; one step has already been made in the downward career of the art or the manufacture. To give an instance of this:—Some years ago, when in India, we were shown some embroideries coming from Kashmir, suitable for trimming ladies' woollen dresses; the designs upon them had most likely been handed down for generations in that country with but few variations, where the tailors form one caste, the goldsmiths another. It was much desired to open out a market for these embroideries in England, where it was thought that they might sell at a remunerative rate, and thus secure a means of livelihood to the 20,000 durzies (tailors), who had been thrown out of employment in Kashmir by the cessation in the demand for the Kashmir shawls which ensued after the Franco-Prussian War of 1870. We admired the embroideries as they deserved, but at the same time remarked that they would not *take* in England with the general public, who are ever seeking novelty; but, let the patterns once be seen in our country, they would speedily be imitated, and appear in a "cheap and nasty form." Our friend looked incredulous, but this prophecy came true; a dress made by a European firm in India eighteen months later was trimmed with a *galon* which was evidently a reproduction (in loom and not hand-work) of one of these Kashmir designs.

In Asia, where conservative principles are retained in everything, in religion, in dress, arts, and manufactures, the people of a particular caste or district are unchanged from what they were a couple of thousand years ago—one particular family or tribe pursues the same calling from generation to generation, *e.g.*, a draughtsman continues to copy the designs which have come down to him from his ancestors; and, even more than this, a goldsmith who belongs to Central or Southern India will be found utterly incapable of making a bracelet similar to one which was bought either in Kashmir or in the Punjab, even if the original be given him to work from.

The people of the so-called Bronze Age in Scandinavia, whom we suppose "Hallyards" would class as Keltic savages, produced, nevertheless, goldsmiths who were most exquisite workers in the most precious of all metals. The Bronze Age in those northern lands is supposed from first to last to have had a duration of about a thousand years, and to have terminated about 100 A.D. Its art has been divided into two distinct periods—the earlier and the later Bronze Age. When we contemplate the objects which have been classed as belonging to the former of these, we at once see what a wide gulf separates it from the Stone Age which preceded it. Whence came this race? They were certainly not in a very low state of civilisation from the very first (the forms of and the designs on their goldsmith's work are witnesses of this fact); in innumerable ornaments made by them, the designs are the same as those we find now existing in Kashmir and in Hindostan proper: we must believe that they brought their cunning with them from Asia; for, not in their personal adornments only, but in the very material which they wore, fragments of which have been found in graves in Denmark which owe their preservation to the oaken coffins which contained them, and in their architecture also we can trace the resemblance to the Asiatic forms adopted by the dwellers in the high and mountainous regions of India, where wood was plentiful as in Scandinavia. A reason which we would urge for the decline of art in Greece is, that at the time when Christianity and Paganism were in a state of rampant antagonism to each other the former (represented by the Byzantine and Greek Churches) adopted a stereotyped form for the representations of the Saviour and the saints; and thus a great barrier arose between Greek religious and secular art as time progressed and Christianity gained a firmer hold on the minds of the people, the material worship of the finest type of human beauty languished, and then became extinct. A very curious thing happened to us when in Greece about six years ago, which gives us ground for the supposition that Greece also originally derived her knowledge of true art from Eastern lands. When visiting Megara, a village about fifty miles from Athens (the occasion being their annual fête), one of our party, then just returned from India, chanced to be wearing a dress trimmed with silver buttons bought at Benares, and other Indian ornaments. Many of the peasant women present seemed much attracted by them, and even went up to the wearer and touched them. A Greek gentleman standing by was requested to inquire why they gazed so intently at these ornaments and desired to examine them closely. Their reply may, we think, serve as an answer to Hallyards' question. It was, "Because they are so like our own!"

Cosmopolitan.

GRAIL AND WHITSUNDAY.

[1931]—The etymologies of "Grail" and "Whitsunday" have been determined on scientific principles. In Skeat's "Concise Etymological Dictionary" they are given as follows, as if expressly in answer to "Hallyards":—

"Grail, the holy dish at the Last Supper (F. L. Gk.). The etymology was very early falsified by an intentional change from *San Greal* (Holy diet) to *Sang Rael* (Royal blood, perversely taken to mean Real blood).—O. F. *graal, greal, grasal*, a flat dish; with numerous other forms both in O. F. and Low L. It would appear that the word was corrupted in various ways from Low L. *cratelta*, a small bowl, dimin. of *crater*, a bowl: see *Crater*."

"Whit-Sunday (E.) Literally *White-Sunday*, as is perfectly

certain from the A.S. name, *hwita sunnan-dæg;* Icel. *hvitasunnudagr;* Norwegian, *kvittsunndag*. These are facts, though constantly denied by the lovers of paradoxical and far-fetched etymologies. The difficulty lies only in the reason for the name. The great festivals, Yule, Easter, and Pentecost, but especially the two latter, were the great seasons for christening; in the Roman Catholic Church, especially Easter, whence in Roman usages the Sunday after Easter was called *Dominica in Albis;* but in the Northern churches, perhaps owing to the cold weather at Easter-time, Pentecost . . . . seems to have been especially appointed for christening and ordination; hence the following week was called the Holy Week, Icel. *Helga Vika* ('Icel. Dictionary'). The case is parallel to that of noon, which at first meant ninth hour, or 3 p.m., but was afterwards shifted. So also in other cases. Derivatives:—*Whitsun-week*, short for *Whitsunday's week* (Icel. *hvitasunnedags-vika*); *Whitsuntide*, short for *Whitsunday-tide*."

Abbreviations:—F., French; O.F., Old French; L., Latin; Gk., Greek; E., English; A.S., Anglo-Saxon: Icel., Icelandic; the sign - signifies derived from.

T. Common.

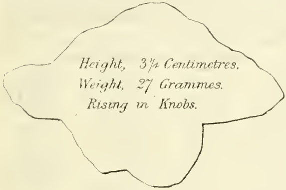
EASTward might keep the moon always due south." I should have considered this a printer's error, but he goes on to say that this traveller would have to travel round the earth in a day AND ABOUT fifty minutes.

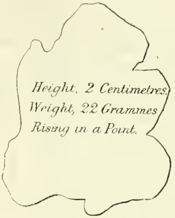
Surely for a person to always keep the moon due south he must travel WESTward at the rate of the earth's revolution on her axis, LESS the distance travelled by the moon eastward, or about fifty minutes in the twenty-four hours.

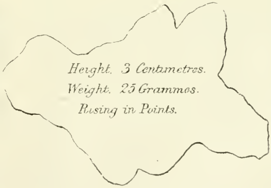
I have been a reader of Knowledge for more than two years, during which time several small changes have taken place generally—in my opinion, for the better. I hope the approaching one will be in that direction.

W. H. S.

[Westward, certainly not eastward; but a day *and* fifty minutes is right and should have shown "W. H. S." that the error was a printer's one. If the man travels at the less rate correctly indicated by our correspondent, will he not take a longer—not a shorter—time in completing the circuit?—R. P.]







A Twin Dandelion.

FALL OF ICE.

[1932]—I send you tracings I made from lumps of ice that fell at this place, that I picked up ten minutes after the storm. The whole day a great deal of rain fell, at about 4 o'clock p.m. rumbling thunder, then a rushing wind, and these lumps of ice fell (part of an ice storm) with slashing rain. The storm lasted about three minutes. I took them down to the chemist and had them weighed and measured, therefore you can be sure of the correctness of what I state. When they actually fell they must have been bigger, for it was raining too heavily. I then had to dress and take them to the chemist's, which took another ten minutes. I wrapped them in a towel to keep them from melting. Saint Martin is about 978 mètres above the sea. I take this from the guide-book.

Isabella Terrell.

Pension Américaine Anglaise, Saint Martin Lantosque, Alpes Maritimes, France, Sept. 4, 1815.

KEEPING THE MOON DUE SOUTH—A PRINTER'S ERROR.

[1933]—I think Mr. Proctor must have made a mistake in his article on "Finding the Way at Sea," on page 177, Knowledge, where he says that a "traveller who could only go fast enough

A TWIN DANDELION.

[1934]—On the 7th inst. I found in a field near here a double dandelion. It has two distinct stalks, but they grow close together (one cuticle surrounding both) till within about an eighth of an inch from the top, where they separate, each bearing a flower. Have any of your readers ever come across such a phenomenon?

Sept. 8, 1885. Ignoramus.

LETTERS RECEIVED AND SHORT ANSWERS.

Jas. Hefferman. With the new arrangements pending the subject of musical beats would not suit these pages. A. J. S. A reply to any rude letter not seen by readers is necessarily suggestive of a tendency to quarrel, and may well appear somewhat egotistical. *That* is precisely why the replies are to be discontinued. Oddly enough the very writers who are rudest are the first to comment on the roughness of retorts. Now, if I were as rude (for example) to you, as you are to me—how would that be? J. You are begging the question in saying that the Spencerian system advocated in my articles on the "Morality of Happiness" involves a lower standard. Even if the other system were followed it would not be higher; for it is less accordant with reason, and man is a reasoning animal. That standard is highest which promises the best results. You would say "shoot at the moon and your arrows though they may

not reach her will go over yonder hill." But this is moonshine if the moon is low. It requires much higher aims, more constant thought, and a more steadfast resolution to combine due regard for others with the necessary care of self than even to try to carry out the purely altruistic system. But if this may be said of the honest attempt to do that, what shall be said of the false and dishonest system by which millions talk of doing it, and never think of even trying to? That is no lofty ideal.—C. E. P. Many thanks; all of those are coming. We have a whole bookful ready. What we should like to have noticed would be any omissions in the alphabetical list. "Spank" for "whip," as you say, and "whip" for "beat" (in the sense of "conquer"). "Begin" ("doesn't begin to") is the only one in your list which needs noting.—F. C. Have not seen the tablet or the Rev. Dr. Howley's argument about Taurus and the Deluge. At a venture—bosh.—J. A. Ollard. You are an old friend of Knowledge; but as for being "fair," I have had four years of hard work on Knowledge for others entirely; I know of no law of fairness which forbids my easing up a little. If but a few of our friends had done each but a little to help, I might have gone on. —Astro. 1. I don't know; if you were to look up the last edition (which you can do quite as readily as I) you would see. 2. Nobody believes now in a cool solar nucleus. 3. Not having the latest edition, cannot say; but as it was published several years after Herschel's death, I presume he made no such alteration in it.—Isabella Terrell. Thanks. Letter and form of the tracings shall appear.—Commentator. We send on no MS. to correspondents, in that way: have not "G.'s" address, even. As regards the admiration you mention, you must be mistaken: I have never expressed any such feeling.—H. E. Brandon. See notices to correspondents.—M. Volk. Cannot devote space to your purpose.—A. S. Barnes. Your criticisms justified. Albeit cause and effect are really interchanged. Thus clouds are caused by lowering of temperature; but they also cause the temperature to fall in places which they shadow—in the summer-time. And so on.—Thomas Willcocks. Quite agree with all you say. Those have been my views for many years.—R. Lewins. Glad you are pleased.—Edward Norris. Many thanks. Book has not yet been forwarded to me at York, but doubtless will soon be.—P. J. Beveridge. I really cannot. Readers object, and very properly, to the introduction of letters which only indicate how and in what degree the writer has misconceived some matter. That is all your letter amounts to. Darwin admitted that one cannot always see in what way the balance in the struggle for life may be affected by some special peculiarity. But admitting this is not giving up the belief that when the balance of advantages *is* affected, however slightly, the circumstance will tell in the long run.—F. Pullinger. A short answer would be worth nothing.—H. O. C. It might be so, if it were so; but it is not so. You never saw cattle and trees magnified by a fog. You thought you did, but you did not. The illusion is well known. You see the objects with a certain amount of distinctness, only when they are much nearer then as usually so seen. Hence they occupy a larger space on the retina, and you suppose they are magnified. If the fog suddenly cleared you would not find them grow less, by a hair's breadth. Magnification by a convex lens is quite another thing.—J. Your experience, I find, agrees with mine. Albeit, those expressions may still be called Americanisms—except "bilin'," which is too commonly heard in England to be less English than American. Words and expressions which are localisms or vulgarisms on this side, but used everywhere in America, may, I think, fairly be called Americanisms. Locke is a man who wrote on the Mind: but no matter.—E. A. Gepp. Most certainly we shall keep up our Whist. —H. A. Miles. Thanks.—A Subscriber from the First. I think with you. But he is a *well-meaning* nuisance.—J. G. G. Do not know.—J. G. S. The nebula is not near any star shown in those elementary maps. It is shown in my "Stars in their Seasons."—R. Lewins, M.D. "It will go near to be thought so, shortly."—A Subscriber. Some say the yolk, others the white. I should say the yolk myself. As to human hair growing after death, I have heard stories to that effect. Safest not to believe them.

Next year's British Association is to be held in Birmingham, and that for 1887 in Manchester, the latter having been chosen in preference to Bath.

We are pleased to notice that there is considerable prospect of the system of train-lighting on the London, Brighton, and South Coast Railway, which was described in Knowledge, No. 174, p. 168, being shortly extended. Its many advantages are apparent. We hear that the system tried on the Great Eastern was an expensive one, inasmuch as seven engines had to be fitted with dynamo, &c., to maintain a single train, consequent on the fact that while carriages can be kept constantly running, engines cannot.

Our Chess Column.

By Mephisto.

Illustrative Game No. 11.

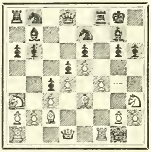
A common error, even amongst many good players, occurs when receiving the odds of Pawn and move or Pawn and two moves from a first class player. They imagine that by avoiding hasty attacks, and merely playing a steady game, they will be able to win finally with the extra Pawn. This is, however, not so, and the belief is soon dispelled after a little experience of first-class play. Purely defensive play or heedless attacks are both equally weak. When receiving the odds of Pawn and moves, it is quite correct, immediately after the Opening moves, not to make an attack against any particular point. But the thing is *to attack the position as a whole.* This advice holds good, more or less, for every Opening. For if your own pieces are well developed and the opponent's position is cramped, then surely enough favourable opportunities for a specific attack will soon be found. But inactivity in the Opening, as in the following game, will enable the stronger player to get over the disadvantage of position, and take the attack in hand himself.

Game played September 12 at the odds of Pawn and two moves:

Remove Black's King's Bishop's Pawn.

White. F. J. Lee.	Black. J. Gunsberg.
1. P to K4	
2. P to Q4	P to KKt3
3. B to Q3	P to Kt3
4. Kt to KB3	B to KKt2
5. P to B3	B to Kt2
6. Castles (*a*)	P to K3
7. Kt to R3 (*b*)	Kt to K2
8. Kt to KKt5 (*c*)	Castles
9. P to KB4	P to B4 (*d*)
10. B to K3	P to KR3 (*e*)
11. Kt to R3 (*f*)	P to Q4
12. P to K5 (*g*)	P to B5
13. B to QB2	P to R3 (*h*)

Black.

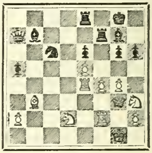


White.

14. P to KKt4 (*i*)	QKt to B3
15. Q to K sq.	P to QKt4
16. Q to R4	Q to K2
17. QR to Q sq. (*j*)	R to B2 (*k*)

White. F. J. Lee.	Black. J. Gunsberg.
18. R to B2	P to Kt5
19. Kt to Kt sq.	QR to KB sq.
20. P to Kt3	P to QR4
21. P × BP (*l*)	QP × P
22. Kt to Q2 (*m*)	Kt to Q4 (*n*)
23. R to K sq.	Kt × B (*o*)
24. R × Kt	P × P
25. R × P	Q × P (*p*)
26. R × P	Q to K6
27. R to K4 (*q*)	Q to R2 (*r*)
28. B to Kt3	R to K sq.
29. Q to Kt3	Kt to Q5
30. R to K sq.	R to B2 (*s*)
31. P to B5	R to B8! (*t*)
32. Q to K3	Kt to B6 (ch) (*u*)
	Resigns

Black.



White.

Notes.

(*a*) Here we have the first illustration of our above remark. There is nothing to be said against Castling in itself, except that it is not a sufficiently active move, and gives Black time to develope. By not Castling too soon, White reserves himself the chance of attacking the weak K's side and Castling QR. Thus, for instance, 6. B to KKt5 would develope a piece and at the same time prevent Black from playing P to K3. Should Black attempt to play P to KR3 in reply to 6. B to KKt5, then White will retire his B to R4, but Black will have a dangerously weak spot on KKt3, and there is nothing to prevent White from reaching it after he plays P to K5.

(*b*) Giving Black more time; a highly important element in this game.

(*c*) His idea being to advance the KBP. But as he may have to retire that Kt later on, it is obvious that it would save a move to play P to KB4 before playing out the Kt to KB3.

(*d*) Black has nothing to fear from White playing P to KB5. Black utilises the first moment after having secured his K to attack White's centre, White, by defending it, gives Black time for further development.

(*e*) Driving the Kt back, in order to be able to move his KP or

QP freely. Black will be better able now to defend his KKt3 if attacked.

(*f*) White's idea being not to put his Kt in the way of his Q or R. But Kt to B3 would probably have been better, as from B3 he could, if feasible, play Kt to R4 later on, with a good chance to press on the weak spot on Black's KKt3.

(*g*) A tempting move, but the following play would have simplified the game in White's favour: — 12. P × BP, P × KP. 13. B to B4, Kt to Q4. 14. B × Kt, P × B. 15. P × P, P × P, &c.

(*h*) To prevent the Kt from reaching the commanding position on Q6 viâ QKt5, also with a view to support the advanced P on B5 against P to QKt3 with P to Kt4.

(*i*) If 14. Q to Kt4, Kt to B4. 15. B × Kt, KtP × B.

(*j*) Some very interesting combinations might have resulted from White's move of 17. P to B5. If Black had replied to this with 17. P to Kt4, White might have continued 18. B × P, P × B. 19. Kt × P, and wins. But if 17. P to B5, KP × P. 18. B × RP, P × P. 19. Kt to Kt5, Kt to B4. 20. B × Kt, P × B, &c.

(*k*) Partly with the object of doubling the Rooks on that file, also to forestall P to B5, P × P, B × RP, as Black, after B × B, Q × B, would have a good reply in R to R2!

(*l*) White was not prudent in taking this P, as thereby Black's QB comes into good play, a chance much desired by Black.

(*m*) White, feeling himself driven back inch by inch, seeks again to reach Q6 with his Kt, only he is one season behind.

(*n*) Taking the initiative in the attack, White cannot play Kt × P, as Black would win a piece by B to R3.

(*o*) Black has left his P on Kt3 en pris, it is, therefore, all important for him not to lose the move. It was difficult to say—as it often happens in similiar positions—whether P × P or Kt × B is better. Kt × B dissolves White's centre, the object aimed at by Black.

(*p*) Black having now opened up the game, is—mindful of its being a game at odds—willing to run some risk for the sake of an attack.

(*q*) In reply to 28. B × P Black would have had nothing better than Q to K8 (ch). 29. Kt to B sq., R to Q2, &c.; perhaps White was unnecessarily afraid of this continuation.

(*r*) Wishing to keep the Rook pinned, with the possibility of bringing the Kt into good play, viâ Q4.

(*s*) Black is now thorough master of the position, and prepares a surprise for White.

(*t*) In this very curious position both Rooks are pinned now. Black threatens to win the Queen by Kt to K7 (ch). White has no good reply. If 32. K to B sq., B to R3 wins, or if 32. B to Q sq., R × B wins.

(*u*) An elegant *coup de grâce*. If 33. Kt × Kt, Q × Q; or if 33. R × Kt, R × R (ch) wins.

Our Whist Column.

By "Five of Clubs."

Returning Partner's Lead.*

Return your partner's lead at once if you have no good suit of your own; but, with a suit which you have reason to think as good as his, you should show your own suit before returning his. If the player on your left has shown extreme weakness in your partner's suit, it is better, usually, to let your partner wait till he gets the lead himself, as it is obvious that the strength lies between him and the opponent to your right; so that your partner, if made third player, will be at a disadvantage.

In returning, *play the higher of two cards, the lowest of three or more.* This is a most important rule. Pay especial attention, also, to the card your partner returns in your suit. If he returns a card which you know (by the play) to be not the highest left in his hand, you may be sure, if he is a careful player, that besides that higher card he holds at least one other.

The exceptions are three. First, if, when you return your partner's suit, you have the best card in the suit, you should lead the best; secondly, with second and third best and a small one, you lead the second best, not the small card; thirdly, with second best and a small one, you generally lead the small one. In the third case, however, it is safer as a rule to refrain from leading back to your partner. If he leads the second time, and the best is on your right, your second best makes. Yet, when your partner's lead indicates great length, it is more important to clear his suit and to avoid blocking it, than to make your second best; in this case you lead second best, and, if it is taken by the best, you still have a small card to lead with a third time, should you have the opportunity; of course, if you are sure you will not have such an opportunity, having no card of re-entry, all you can gain by leading the second best is to clear, or help to clear, your partner's suit.

* From the Author's forthcoming work entitled "Home Whist."

In trumps the rule for returning the higher of two cards, the lowest of three or more, is even more important than in plain suits. But in all suits it should be carefully followed.

Discarding.

When you have to *discard*—that is, when you cannot follow suit —your natural course is to play the card you can best spare. And usually, for the same reason that your longest suit is usually the one you most value and in which you have the greatest reliance, your shortest suit is the one you value least, and from which, therefore, you make your first discard. Still it is manifest that often mere length affords no criterion of value. If you have four small cards in one suit and King or Queen with but one or two *guards* (or small cards) in another, you would prefer to discard one of the four small cards, which are alike worthless, to discarding one of the guards of the King or Queen, which may lead to the downfall of the royal card before the enemy's Ace.

The general rule, then, for the first discard is, that *while as yet the relative strength of the hands is unknown* it should be from your shortest suit unless that suit needs protection, in which case you discard from the suit of least value. This rule may be put in a form which I have often found convenient in teaching Home Whist—so long as you do not know how the strength of the hands lies, let your first discard be from the suit you would least like your partner to lead.

When strength, and here I refer specially to trump strength, is declared in your favour, this rule should always be obeyed.

But, when strength in trumps is clearly against you, cautions play is necessary. The enemy are manœuvring, or will presently manœuvre, to bring in a long suit. It is essential, therefore, that you should retain, as long as you can, any command you may have in their strong suits. Therefore you must avoid discarding from those suits, if, by so doing, you dangerously reduce the number of guards protecting whatever high cards you may have in them. It is safer to discard from your own longest suit, in which you are usually well protected. If trump strength is heavily against you, you lose nothing by discarding from your long suit, simply because you have no chance of bringing in the complete suit.

Therefore we have this general rule—*when trump strength is against you*, your first discard should be from that suit which you can most safely unguard. As this is usually your longest suit, your partner has some reason for inferring that your first discard is from your best suit when trump strength is declared against you. But I reject as utterly unsound the doctrine that your first discard in such a case should be regarded as directing your partner to lead the suit from which you have discarded. It is not a sound rule that you should always discard from your longest or your best suit when the enemy have the trump strength. If you have two or three worthless cards in one of the enemy's suits, you ought to discard from them, seeing that they can do you no possible good. It is a misfortune for you that you should have to discard from your best suit, as too often happens when the enemy are strong in trumps; it is a misfortune also to have a suit of two or three worthless cards; but it is the height of absurdity, if the second misfortune has befallen you, to add the other, by discarding from a strong suit when you have really worthless cards to throw away. You must remember, however, that small cards in your partner's suit are by no means worthless, as you may want one or more of them to lead to him with.

The modern doctrine of uniformity at Whist is sound enough, as a general doctrine, but this doctrine has run mad when it teaches, as some of its modern exponents make it teach, that for the sake of uniformity good cards should be thrown away and worthless cards retained. Of course it would be a great convenience if we could have such a rule for discarding against trump strength as would render judgment unnecessary, and enable your partner at once to decide in which suit you have most strength. But, as no such rule can be adopted without causing occasional offence against the great Whist rule, that "You should play to win," room must still be left for judgment in discarding against strong trump hands.

Observe, however, that if you see clearly that you will have to discard more than once, with strength in trumps against you, and that one of these discards must be from your best suit, then let your *first* discard be from that suit.

In all cases, observe that the first discard is the directive one. Thus when nothing is as yet known about the trump strength, or when trump strength is decidedly on your side, the first discard shows your weakest suit, and directs your partner to one or other of the two remaining plain suits as your best.

When you have to discard from a suit in which you have entire command, discard the best. Never discard the second best of a suit unless you hold it single. If you hold alone the best of a suit in which your partner has entire command, and it is certain that he will presently get a lead in the suit, get rid of the card at the first opportunity, or it will block his suit.

(*To be continued.*)

Our Inventors' Column.

*We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (*KNOWLEDGE *being a popular magazine) than is accorded by the most excellent trade journals*

IMPROVEMENTS IN BRINSMEAD PIANOS.

PIANOFORTES have hitherto been regarded in a double aspect—both as musical instruments and as articles of household ornamentation; and we make bold to say that, with many people, the latter consideration has predominated to such an extent as to give rise to the practice, on the part of unprincipled manufacturers, of enclosing worthless mechanisms—from a musical point of view—in cases constructed simply with a view to their effective appearance. The purchasers of these "musical boxes" soon discover, however, that they have sacrificed their sense of sound to their sense of sight, but too late in many cases to remedy the evil; for pianoforte-buying with most people is an affair of once for all time rather than an everyday occurrence.

With the idea of remedying to a great extent this state of things, the well-known firm of Brinsmead & Sons have introduced, and are exhibiting at the Inventions Exhibition, an improvement in the construction of pianos which cannot fail to commend itself to all concerned. The pianoforte is now manufactured by them and shown complete, irrespective of the cabinet-work, which is altogether a subsidiary after-consideration. It is not merely the ordinary "Brinsmead" previous to encasement that is exhibited, however, but a complex development of the latest inventions of the firm, resulting in a mechanical structure challenging approval or condemnation on its merits as a tone-producer alone, an inspection and study of which convinces one that a forward step has been taken by the manufacturers in the interests of the musical art. The illustrations given herewith show the front and back view of their Patent Consolidated Iron Piano; an examination of these will present a better idea of the mechanical improvements effected than could be afforded by mere verbal description.

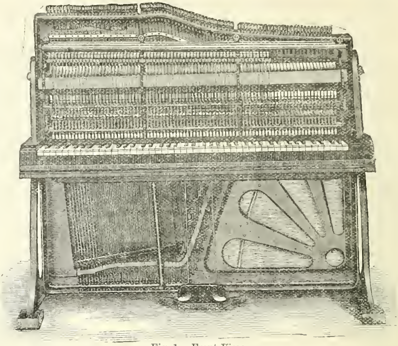


Fig. 1.—Front View.

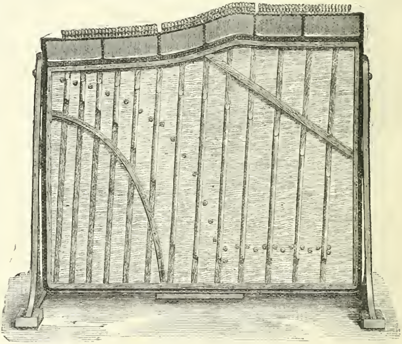


Fig. 2.—Back View.

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Contents of No. 204.

SWIFTLY-MOVING METEORS.*

The earth is now traversing that part of her annual course in which her northern hemisphere is most directly exposed to meteoric downpour. The northern hemisphere may be compared at this season to an umbrella carried somewhat in front by one who travels through a rainstorm drifted by a wind which he is facing, whereas in the spring months the northern hemisphere is like an umbrella carried over the shoulders for protection against rain blown after the traveller. When we face the drifting rain it comes down more sharply on us than when we are retreating from it. So is it with the earth; and thus we have at this season a greater number of meteors falling on our northern hemisphere, and those which reach us fall on our air (the earth's umbrella, one might almost say, seeing that it in reality protects her from the meteoric shower) more sharply than during the months of spring.

At this season, then, the observers of meteors and falling stars have more favourable opportunities than during any other part of the year. And meteoric observations are now much needed, for a discovery has been announced respecting meteors which, if real, is one of the most interesting ever made. But it needs very careful testing.

Every one knows, or should know, that meteors are bodies which enter the earth's atmosphere from outside. They had been travelling on orbits of planetary, perhaps more than planetary, extent, with velocities even exceeding the swift rush of our earth on her annual course. Encountering her upon their way, they rushed into the air which shields her from actual mischief, were caused to glow by the friction arising as they swept through this air at the rate of thirty or forty miles per second, and, being vaporised by the intense heat, their careers as separate bodies came to an end.

So swift have been the movements of all meteors yet observed, that the motion of the observer as he is carried round the earth's axis (at the rate of ten or twelve miles per minute in our latitude) does not appreciably affect the apparent direction of meteoric inrush. This is shown by the circumstance that even where a display of meteors—a shower of falling stars—has lasted five or six hours, the apparent direction of the meteors has remained appreciably unchanged. Their "radiant point," or the "vanishing point" of their parallel tracks, as seen projected on the star-sphere, has remained in the same position among the stars all the time, although in six hours the direction in which the earth's rotation carries the observer is changed through a right angle. This, of course, was to be expected, because a velocity of ten or twelve miles per minute is as nothing compared with a velocity of thirty or forty miles per second.

But it is quite different with the earth's motion of revolution. This carries the observer along at the rate of $18\frac{1}{2}$ miles per second. If the direction of this motion changed while a shower of meteors lasted, then assuredly we might expect that the apparent directions of the meteors' courses would change too. We might, indeed, be sure that they would change in a marked degree even though the meteors were travelling along with the greatest velocities meteors can have when crossing the earth's path on any closed orbit—viz., twenty-six miles per second.

But then the direction of the earth's motion around the sun does not appreciably change during the usual continuance of a display of falling stars. In a whole day it only changes one degree, which is as nothing. It takes three months to change through a right angle, instead of six hours, the time during which the direction of her motion of rotation changes by that amount. So that it might have been supposed that we need never look for any change in the apparent direction of meteoric motion on account of a change in the direction of the earth's motion in her course around the sun.

Now, however, comes the announcement—or, rather, the announcement has been in the air for full five years—that there are meteors which pour in upon the earth in the same unchanged direction for four or five months at a stretch, some of these belonging to well-known systems, or, rather, to systems supposed to be well known till this strange discovery was made respecting them. Mr. Denning, of Bristol, who has long been known as a careful observer of meteors, stated in 1880 that he had observed meteors coming night after night from the same radiant point among the stars for several months in succession. It was pointed out immediately that if such were the case, and such meteors travelled only with ordinary meteoric velocities, the apparent persistence of the radiant point proved incontestably that the meteors belonged to different systems, and not, as Mr. Denning supposed, to one and the same system. The reasoning on which this depends is not theoretical, but demonstrative. It may be very easily illustrated. Suppose a steamship travelling at the rate of eighteen and a-half miles an hour (geographical or nautical miles, it matters not which), and that there is a wind blowing at the rate of twenty-six miles an hour in an unvarying direction, say from due north. Then it is certain that if the ship changes her course through a right angle by sweeping round, with unchanging velocity, through a quarter of a large circle, the apparent direction and velocity of the wind will seem to change considerably. If, for instance, the ship was at first steaming due north, meeting the wind, she was exposed to an apparent north wind of forty-four and a-half miles an hour. If she turned round in a large arc towards the east the wind would seem to

* From the *Times* of Sept. 16.

grow less and less violent, and to come more and more from the east, until when she was steaming due east it would seem to come from somewhere about north-east by north, and with a velocity of about thirty-two miles an hour. If she still continued her circuit the wind would gradually return in direction towards the north, still diminishing more and more in velocity till she was steaming due south, when the wind would seem to reach her as a north wind having a velocity of only seven and a-half miles an hour. Similar changes would have been observed had she turned originally towards the west, the direction of the wind changing apparently more and more to the west, till it was about west by north (when she was steaming due west), then becoming more and more northerly again, till it appeared as a north wind of seven and a-half miles an hour. It is manifest that if, instead of these changes, the wind remained all the time apparently a north wind, that would prove, not that the wind had really remained a north wind, but that the wind had changed, the change by some odd chance coinciding with the change in the ship's course so precisely as to leave the apparent wind all the time northerly. An apparently north wind felt on a ship steaming rapidly eastwards must of necessity be a wind with a good deal of west in it, and *vice versâ*.

There is but one way of interpreting the steady continuance of a meteor shower in the same apparent direction while the earth is greatly changing her direction. We have only to consider the illustration just used to see what that way is. If the velocity of the wind were enormously greater than that of the ship, no change in the ship's course would appreciably affect the apparent course of the wind. The ship might steam round and round in a circle at the rate of one mile an hour without noticeably affecting the apparent direction of a wind blowing steadily at the rate of fifty miles an hour. If it were a north wind, it would seem a north wind whether she steamed east or west north or south. Nor would the northerly wind of fifty-one miles an hour she would seem to encounter when steaming due north seem noticeably stronger than the northerly wind of forty-nine miles an hour blowing over her when she was steaming due south.

If this explanation were allowed in the case of those meteors which Mr. Denning believes he has observed to pour in upon the earth in the same unchanged direction for months in succession, then we should have to assume that the real velocities of these bodies amounted to 200 or 300 miles per second at least. If so, they would assuredly not be attendants on our sun. They must have possessed the greater part of those enormous velocities long before they reached our system, and they must be carried away again by those excessive velocities into the interstellar depths never to return, unless actually captured by our earth or some other planet.

But, unfortunately for our peace of mind, neither Mr. Denning, who brings his discovery of "stationary radiants" before us, nor Colonel Tupman, who endorses the discovery after long resisting it (and who has mathematical knowledge for his guidance), will admit that such enormous velocities exist. They trust in those multiple observations of bright meteors in which one observer, perhaps in Yorkshire, announces that the meteor track ran from near such and such a star to near such and such another star, and was traversed in about three-quarters of a second; while another observer, say in Oxfordshire, notes that as seen from his more southerly station the meteor track was different, the duration of flight being estimated at about half a second. Such observations are unsatisfactory, for there is nothing more difficult to estimate than the time in which a body suddenly appearing has rapidly traversed a certain track before as suddenly disappearing. But on the strength of such observations Mr. Denning and Colonel Tupman practically reject the observations of stationary radiants which they had seemed to accept. It is absolutely certain that if meteors seem to come from the same direction within a degree or so for months they must travel much more swiftly than the earth. If, then, there are no meteors travelling so rapidly, there can be none which retain their apparent directions unchanged for months.

The inquiry is one of singular interest, because if there are such swiftly travelling meteors we have to adopt strange ideas as to their origin and the cause of their tremendous velocities. If there are not, we must cease to rely so confidently as heretofore on the estimates which Messrs. Greg, Denning, Alex. Herschel, and others have formed respecting the radiants of the various meteor streams. In either case, it is clear that the meteoric field of inquiry requires many new labourers.

MYSTERIES AND MORALITIES.

By EDWARD CLODD.

VIII.

IN comparing the several plays on kindred subjects in the four series of English Mysteries, one is sorely tempted to continue extracts from them in detail, the more so on account of the rarity of the volumes, all of which, the recently-published York plays excepted, have been long out of print. But such enlarged abstract would, even if space permitted, needlessly tax the patience of our readers, the majority of whom will be content with a general idea of the character and literary ability of these forerunners of the English drama, and of the sincerity, earnestness, skill, and, on the whole, good taste with which the primitive dramatists converted Bible story into Mystery Play. There are, however, among the twenty-five or thirty pageants yet unnoticed three or four which demand attention before some account of the Moralities is given—namely, *The Oblation of the Three Kings*; *The Temptation*; *The Dream of Pilate's Wife*; *The Crucifixion*; and *The Harrowing of Hell*.

In the first of these, the conception of Herod as a swaggering boaster is common to all the series. Notably, in the York variant, the most elaborate of the four, does he in alliterative rhymed lines play the braggart :—

Herod. The clowdes clapped in clerenes that ther clematis in-closis (climates encloses)
Jubiter and Jouis, Martis and Mercury emyde,
Raykand ouere my rialte on rawe me reioyses,*
Blonderande ther blastis, to blaw when I bidde.
Saturne my subgett, that sotilly is hidde,
I list at my likyng and laies hym full lowe;
The rakke of the rede skye full rappely I ridde,
Thondres full thrallye by thousandes I thraw
when me likis;
Venus his voice to me awe
That princes to play in hym pikis (choose).

The prince of planetis that proudely is pight
Sall brace furth his bemes that oure belde blithes,
The mone at my myght he mosteres his myght:
And kayssaris (emperors) in castellis grete kyndnes me kythes (show),

* *i.e.*, I ride on the wandering clouds.

Lowdis and ladis too luffely me lithes,
For I am fairer of face and fressher on folde
(The soth yf I saie sall) seune and sextis sithis (times),
Than glorius gulles that gayer is than golde
in price;
How thynke ye ther tales that I talde,
I am worthy, witty, and wyse !*

Similarly alliterative is the speech in the Coventry play, the metre in which is often lyrical.

Herode. As a lord in ryalté in non regyon so ryche,
And rulere of alle remys I ryde in ryal aray;
Ther is no lord of lond in lordchep to me lyche,
Non lofflyere, non lofsumere, evyr lestying is my lay:
Of bewté and of boldnes I bere evermore the belle;
Of mayn and of myght I master every man:
I dynge with my dowtynes the devyl down to helle,
ffor bothe of hevyn and of herthe I am kynge sertayn,†

In the Towneley play he boasts that "alle shall bowe" to him and "Sant Mahowne,‡ and, as in the York and Chester, when a messenger announces to him the approach of the three kings "sekeand a barne," he is furious at hearing that there are other kings beside himself:—

Kyng! what the dewylle other than I!
We, fy on dewylls; fy, fy!

They arrive on horseback (evidencing to the probable employment of horses in the pageant)§ and on being summoned to Herod's presence, they tell him that they seek a child "nowe borne" who shall be "kyng of Jewes and of Jude." Herod is enraged at this, and threatens their lives, but is advised by a crafty counsellor to lay a trap for them,|| and gives the kings leave to go to Bethlehem on condition that they return and bring him true tidings. The plays adhere to the New Testament narrative in the incidents that follow, namely, the offerings to Jesus and the return of the Magi another way in obedience to the angel's warning.

Tertius Rex. Oure God I blysse
He sent us i-wys
His aungel bryght.
Now we be wake,
The way to take
Home fulle ryght.¶

In the pageant of *The Temptation*, which is absent from the Towneley series, and in the Chester series includes the story of the woman taken in adultery, the Coventry play is opened by a council in hell, whereat Sir Sathanas confides to Belyard and Belsabub, his "der worthy develes of helle," his doubts as to the mischief "Cryst if he be goddes child" may do, hewing "downe alle oure lore and alle oure lawe." Belsabub advises "lovely Lucyfer to tempte hym in synnys thre," and in the scene between the devil and Jesus amusing evidence of the eccentric geography of the period is given in the list of this world's kingdoms as seen from the "exceeding high mountain." It reminds us of the explanation profanely suggested when the difficulty of seeing both hemispheres at once was pointed out, that the devil must have had a map of the world on Mercator's Projection before him!

Sathan. Into the northe loke fforthe evyn pleyn,
The towre of Babylony ther mayst thou se;
The ceté of Jerusalem stondyth ther ageyn,
And evyn ffast therby stondyth Galylé.
Nazareth, Naverne, and the kyngdom of Spayn,
Zabulon, and Neptalym, that is a ryche countré,
Both Zebee and Salmana, though mayst se serteyn.
Itayl and Archage that wurthy remys be,
Bothe Jannense and Jurye.
Rome doth stonde before the ryght,
The Temple of Salamon as sylver bryght,
And here mayst thou se opynly with syght
Bothe ffraunce and Normandye.

Turne the now on this syde and se here Lumbardye
Of spycery ther growyth many an c. balys:
Archas and Aragon, and grett Almonye,
Parys and Portyngale, and the towne of Galys:
Pownteys and Poperynge, and also Pycardye,
Erlonde, Scottlonde, and the londe of Walys.
Grete pylis and castellys thou mayst se with eye,
Ya, and alle the wyd werde without mo talys,
Alle this longygh to me.
If thou wylt knele down to the grownde,
And wurchepp me now in this stownde,
Alle this world, that is so rownd,
I xal it gyve to the !*

The York play follows the terseness of the Scripture narrative:—

Behalde now, ser, and thou schalt see,
Sere (several) kyngdoms and sere contre;
Alle this will I giffe to the
For euer more,
And thou falle and honour me
As I saide are.†

The devil, angry at his defeat, leaves inodorous traces of his presence behind him, and, as in the Gospel story, angels minister unto Jesus. Satan comes to the front a good deal in the pageants that follow, notably in the Coventry play of the *Council of the Jews* where, disguised as a gallant, he makes a boastful speech, qualified by memories of his discomfiture at the hands of Jesus, and gives a minute and curious description of his own dress and manners.

In *Pilate's Wife's Dream*‡ Satan brags that he will avenge his defeat on Jesus:—

Sathan. Ffor alle his barfot goyng, fro me xal he not skyp,
But my derk dongeon I xal bryngyn hym to,

and calls on hell to "make redy chenys to bynd hym with in lake." But a demon warns him that if he lets Jesus into hell the door will be opened to let all the damned out, whereupon Satan repents the part he has played in bringing about the death of Jesus, and hastens to Dame Procula,§ Pilate's wife, to urge that she counsels her husband not to condemn Jesus. *Here xal the devyl gon to Pylatys wyf, the corteyn drawyn as she lyth in bedde; and he xal no dene make; but she xal sone after that he is come in, makyn a rewly (rueful) noyse, comyng and rennyng of the schaffald, and her shert and here kyrtyl in here hand, and sche xal come beforn Pylat like a mad woman. Seyng thus,*

Uxor Pilaty. Pylat, I charge the that thou take hede!
Deme not Jhesu, but be his frende!
Yf thou jewge hym to be dede,
Thou art dampnyd withoutyn ende!
A fend aperyd me beforn,
As I lay in my bed slepyng fast:
Sethyn the tyme that I was born
Was I nevyr so sore agast!

* *York Mystery Plays*, pp. 123-4. † *Coventry Mysteries*, p. 161.
‡ According to Skelton's *Why come ye not to Court?* Mahomet, who is only mentioned and sworn by in the three existing MSS. of *Plays of Miracles*, formerly figured in some of them *in propriâ personâ*:—

"His servauntes menyal
He dothe revile and brall,
Like Mahound in a play."
—Collier's *Hist. Dram. Poetry*, ii. 115.

§ In the Towneley play this stage direction occurs: *Here lyghtes the Kynges of thare horses*, page 131.
|| Matthew ii. 8. ¶ *Coventry Mysteries*, p. 171.

* *Coventry Mysteries*, pp. 210-211. The omission of England from the list is curious.
† P. 183.
‡ Matt. xxvii. 19; Gospel of Nicodemus, ch. ii., and *Ib.* part 2, ch. iv. Cf. Cowper, pp. 235, 257.
§ *Procla* in Gosp. Nicod.; *Percula* in *York Play*, p. 272.

In the York play Percula sends her son to tell Pilate the dream :—

Sir, that comely comanndes hir youe too,
And sais, al nakid this nyght as sche napped,
With tene and with traye was sche trapped,
With a sweuene (dream) that swiftely hir swapped (struck)
Of one Jesu the juste man, the Jewes will undo.
She beseches you as hir souerayne that symple to saue
Deme hym noght to deth, for drede of vengeaunce.*

In the Coventry play of *The Crucifixion*, Pilate, vacillating and disquieted in mind, brings Jesus before the crowd, who shout that they have "no kynge but the Emperour alon." *Here* (says the stage direction) *thei xal bryngе Barabas to the barre, and Jhesu, and ij Jewys in here shertys bare-leggyd, and Jhesus standyng at the barre betwyxt them ; and Annas and Cayphas xal gon into the councelle hous qwhan Pylat syttyth.*† Barabbas is freed, and Pilate delivers Jesus to scourging and death, with, as the York play has it, "a harlott on aythir side hym." This term, it may be noted, was originally applied to either sex, and not always in a very bad sense, being equivalent to our "fellow." The etymology is of uncertain origin. Probably it comes from Old High German *karl*, a man.

The legend of Veronica,‡ one of the women who, meeting Jesus sinking under the burden of the cross on his way to Calvary, offered him her handkerchief to wipe the sweat from his brow, when his features were miraculously imprinted on the handkerchief, is woven into the plays.

In the Coventry, when, in the stage direction, *sche whypyth his face with her kerchy*, Jesus says :—

Veronyca, thi whipyng doth me ese !
My face is clene that was blak to se :
I xal them kepe from alle mysese
That lokyn on thi kerchy and remembyr me !

Then *thei pulle Jhesu out of his clothis and leyn them togedyr ; and ther thei pullyn hym down and leyn along on the cros, and after that naylyn hym thereon*, while they begin "dawncyn abowte the cros" amidst the mockings of the onlookers, the lamentations of the women, and the cry of the crucified to his "Fadyr in hevyn." In both the York and Towneley plays the scene was invested with a grim realism by the stretching of the victim on the cross, the knitting of knots to bind him, the driving of nails through hands and feet, and the upraising of the cross with noise of hammers as they fit it into the mortice and set it fast with wedges. The drawing of lots for the garment of Jesus is in the Towneley series made the subject of a farcical play—*Processus Talentorum*, in which Pilate delivers a prologue in lines half English, half monkish Latin, boasting of his royal descent :—

Stemmate regali, Kyng Atus gate me of Pila (hence Pilatus),§
Tramite legali I am ordand to reyn apon Juda ;

but adding that "nomine valgari Pownce Pilat." He then lies down to sleep, when three of the torturers of Jesus enter to obtain his decision as to who is to have the "cote," and on his awakening he haggles with them to secure the "gowne" for himself, suggesting that they should draw cutts (lots) for it, to which they agree, until he claims first draw :—

Pilatus. We, me falles alle the fyrst, and forther shalle ye.
Secundus Tortor. Nay, drede you not doutles, for that do ye not,
O, he sekys as he wold dyssave us now we se.

Tercius Tortor then produces "thre dyse"* to the throwing of which Pilate, after more haggling, agrees, and although Tercius Tortor, by name Spill-payn, wins, Pilate by coaxing and threatening secures the garment, the Tortores cursing the dice and moralising on the vice of gambling :

Tercius Tortor. What commys of dysyng I pray you hark after
But los of good in lakyng (playing) and oft tymes men's slaghter !
Thus sorow is at partyng, at metyng if ther be laghter,
I red leyf siche vayn thyng and serve God herafter
For heven's blys ;

Pilate dismisses them with an artful compliment as "most conyng clerkes," and commends them to the care of Mahomet :

Mahowne most myghty in castels and towres
He kepe you, lordynges, and alle youres,
And havys alle gud day.

Of these sacred dramas the Passion Play performed at Ammergau, a village in the Bavarian mountains, is the sole extant representative. When, about one hundred years ago, the Prince-Archbishop of Salzburg forbade the further performance of Mysteries and Miracle Plays, the inhabitants of Ammergau were excepted from the prohibition, that they might remain faithful to a vow made in 1633, on the cessation of a dreadful plague, that the Passion of Jesus should be performed every tenth year in token of their thanksgiving. That performance has taken place decennially ever since, the last occasion being in 1880.

* *York Mysteries*, p. 282.

† *Coventry Mysteries*, p. 311.

‡ For other legends of Veronica cf. Cowper's *Apoch, Gospels*, pp. 416, 434, 441, fp.

§ For sir Sesar was my sier,
And I sothely his sonne ;
And my modir hight (named) Pila that proude was o pight (sets),
O Pila that prowde and Atus hir fadir he hight.
York M.P., 271.

MERCURY IN A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

[The delay in the appearance of this final paper of a series commenced on p. 201 of the first volume of Knowledge, has had its origin wholly in the fact that for the last two years the planet Mercury has been invisible in the instrument which we have employed for the purposes of description and illustration ; he having been obscured by the strange halo which, certainly since the beginning of 1883, has surrounded and extended to so considerable a distance from the Sun. It was not until the morning of Tuesday, September 15, that we at length succeeded in obtaining an available observation of the planet.]

MERCURY in a three-inch telescope is, to speak as euphemistically as possible, a rather disappointing object. Nor is the reason far to seek. Even in inferior conjunction—when (save during the rare occasions of his transit over the Sun's disc), he is, of course, invisible his diameter scarcely exceeds 10″ ; while at the times of his greatest elongation—east or west of the Sun, as the case may be—his little crescent only measures some 7″ from cusp to cusp. Hence it becomes necessary to employ as high a power as our telescope will bear to get any idea of the planet's figure and general appearance ; while as to the detail alleged in astronomical works to have been seen on his surface, the possessor of such an instrument as that with which our observations are made must be content

* Among the items of expense given this occurs. "Imp. iiij. Jakkets of blake bokeram for the tormentors with nayles and dyse upon them." *Dissert. Cor. Myst.*, p. 16.

to walk by faith, and not by sight. The explanation which we gave on p. 92 of Vol. VI. of the phases exhibited by Venus is equally applicable, *mutatis mutandis*, to those shown by Mercury, and the reader is requested to refresh his memory by a re-perusal of what was said in the place cited, for the better apprehension of what is to follow. Mercury then attained his greatest elongation west of the Sun (p. 231) at 7 p.m. on the 18th, and hence, at the date of our observation, he was about three days and a half from it. A glance at the figure

Mercury, Sept. 15, 1885. Power 160.

will show that the illuminated portion of the planet visible was decidedly *smaller* than it should theoretically have been from the relative positions of the Sun, Earth, and Mercury. As may be imagined, however, some attention is needed to detect this feature in so tiny a crescent as the planet presents. The shading towards the terminator, or apparent inner edge of the crescent, is both considerable and ill-defined. Whether this has its origin in the planet's atmosphere or not is by no means easy to determine. The student, after scrutinising Mercury, should turn his telescope upon Venus, the brilliance of whose light stands out in striking contrast to the comparatively feeble illumination of her inner neighbour. Spots, streaks, &c. (whence a hypothetical rotation period has been deduced), and a blunting of at least one of the horns of the crescentic planet have been seen, either objectively or in imagination, by many observers; but, as we have hinted above, all such detail is hopelessly beyond the possessor of a small instrument.

As in the case of Venus, when Mercury is in or near either of his nodes at the time of inferior conjunction, he passes across the Sun's disc—or, as it is technically said, "Transits" the Sun as a black spot. With too light an eye-shade he shows well the notorious ligament or black drop (concerning which so much has been written in connection with transits of Venus) at his entry on and exit from the Sun's face. An aureola or luminous ring round the black disc of the planet has also been seen while it has been crossing the Sun; while several observers of skill and repute have seen one, and even two, whitish spots on the dark disc of the planet itself under the same conditions. These phenomena are quite within the reach of such a telescope as that whose use we are pre-supposing; but, unfortunately, the student will have to wait some time before attempting to verify such observations as those which we have just described, inasmuch as only two more Transits of Mercury will occur during the present century: the first happening on May 9, 1891, and the next on November 10, 1894.

At the Royal Arsenal, Woolwich, on Tuesday week, a tank containing several thousand gallons of oil took fire. It was the oil in which the tubes for the steel guns was tempered. All that could be done was to remove and extinguish the burning wooden covers, and to at once close down the boiling fat with sheets of iron covered with ashes.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

HYMENOPTERA.

Though the order Hymenoptera is a very extensive one, including, as it does, the bees, wasps, ants, ichneumon flies, saw-flies, and gall-flies, it will not detain us long, as only a very few of its members can legitimately be claimed as household insects. Bees, saw-flies, and gall-flies are so intimately associated with living plants, that there is nothing to tempt them indoors, and it is only amongst the parasitic ichneumon flies and their allies, and the omnivorous ants and wasps, that we can expect to meet with domestic examples.

We will first take the ants. Of these insects we have one species that is found exclusively in houses; it is not a truly British insect, but has been imported with merchandise; it does not seem to have been noticed here before the year 1828, nevertheless it has completely established itself, and, having found supplies plentiful, and the climate of our houses congenial to its taste, it will no doubt remain with us. At different times it has been known to English entomologists under a variety of names. In the latest systematic work on this particular group of insects, the "British Heterogyna and Fossorial Hymenoptera" of Mr. Edward Saunders, it is called *Monomorium Pharaonis*, but it was formerly known as *Myrmica molesta* and *Diplorhoptrum molestum.*

Ants, as is well-known, are what are called social insects, that is, they form large communities, which are something more than mere collections of many individuals of the same species living in close proximity to one another (in which case they would be called gregarious, but not social); they form well-organised societies, the members of which share a common dwelling, and contribute to the common well-being by their united exertions in erecting or excavating the abode, in providing the common stock of food, and in rearing the young. Insects which manifest this social instinct exhibit the further peculiarity that the species is constituted not of two, but of three, distinct factors, which are frequently called males, females, and neuters, though the last-mentioned are more suitably denominated workers. As far as British insects are concerned, the only truly social species are ants, certain wasps, the humble bees, and the hive bee, and it is only in these that the three so-called sexes are found. There is nothing comparable to the worker in any other British insects, whether Hymenopterous or otherwise. In the highest development of the social community, such as is met with in the hive-bee, the males and females are simply concerned with the propagation of the species, whilst the various labours of the community are performed by the workers, who are themselves incapable of reproducing their kind, and are by some supposed to be a kind of abortive females.

Now in the ants, the males and females are, primarily at any rate, winged, but the workers are always wingless; moreover, the males and workers are usually smaller than the females, sometimes very much so, and the workers are usually also smaller even than the males. The males and females appear in the late summer or autumn, and the former perish after pairing, so that their period of perfect existence is a very short one. The females, previous to undertaking the duties of maternity, lose their wings, which either drop off spontaneously, or are torn off by the workers. Winged ants, therefore, are only to be seen at certain seasons of the year, and the majority of the wingless creatures that we commonly

speak of as ants, and that are so frequently seen running about on the ground, are merely the workers.

So much with respect to ants in general. We may now proceed to the study of the particular species above referred to—viz., *Monomorium Pharaonis*. It is a minute, reddish insect, which, though apparently not yet distributed throughout the country, being most plentiful in the south-east, is nevertheless very abundant where it occurs, and therefore, in consequence of its voracious habits, a source of considerable annoyance. The worker (Fig. 1), the only member of the community usually seen, is reddish-yellow in colour, and is very minute, being scarcely $\frac{1}{12}$ in. in length, and so one of the smallest of our British ants. There is a peculiarity in the abdomen of this little creature which at once reveals the family to which it belongs. British ants are divisible into three families—the *Formicidæ*, the *Poneridæ*, and the *Myrmicidæ*. The last is readily distinguished from the other two by the fact that the first two joints of the abdomen are much narrowed, so as to form what is called a "petiole," because it seems as though the abdomen were united to the thorax by a kind of stalk; in the other two families it is only the first joint that is modified in this way. Microscopical examination shows that our present insect has two lobes to the petiole, therefore it belongs to the *Myrmicidæ*. These two lobes are considerably raised or swollen above, so that when the insect is viewed in profile its contour presents a succession of elevations and depressions (Fig. 2).

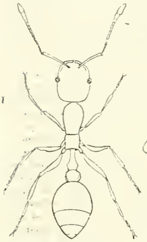


Fig. 1.—Worker of Monomorium Pharaonis.

Fig. 2.—Side view of body of same.

The head is very large, and the antennæ are about half as long as the whole body, elbowed at the base, and clubbed at the tip. Two black specks at the sides of the head are the compound eyes, which, for an insect, are unusually small in proportion to the size of the head. The abdomen is smooth and shining, but the rest of the insect is dull, in consequence of the minute and close punctuation with which it is covered.

The life-history of an ant is similar to that of a bee. It commences life as an egg, which is very minute, as might be expected from the small size even of the perfect insect. The oval, yellowish-white objects so frequently found in ants' nests in the summer, and popularly called "ants' eggs," are not eggs at all—a conclusion the truth of which a little thought would at once render apparent, since they are as big as the insects themselves, and therefore could not be their eggs. From the eggs are hatched little footless maggots of a whitish or greyish colour, which are tended and fed with great assiduity by the patient workers.

In due course they become pupæ, in which condition they resemble in shape the perfect insect, but have, as usual, all their limbs folded up underneath them. Previous to the assumption of this stage, some ants, such as the *Formicidæ*, envelope themselves in an oval silken cocoon, and thus acquire a resemblance to eggs; and it is these pupæ, thus enveloped, that constitute the so-called "ants' eggs" referred to above. But the *Myrmicidæ*, to which our present insect belongs, do not form cocoons, but pupate without this protection. The pupæ, since they are more helpless even than the larvæ, equally need the care of the nurses, though there is now no feeding to be done.

When the insect is ready for its final change, there is still more work for the nurses to do; they have to assist it out of its enveloping pellicle, to help it straighten its cramped limbs, to lead it about the nest, and generally, to introduce it to all the activities of its new life.

We have said that these little ants have a voracious appetite; this the householder who is unfortunate enough to shelter colonies of them in his dwelling will soon find out. Nothing edible comes amiss to them, but they are specially partial to sweets and greasy substances. Cakes, pastry, sugar, and dripping may perhaps be said to be their especial favourites. Any dainty little morsels which the careful housewife has put away, as she thinks, in safety, ready for future use, are soon found out by stray members of the ant community; the news is telegraphed to the rest, and soon crowds are wending their way to the feast. When once they have assembled in considerable numbers at the place of entertainment, it is difficult for their human foe to know how to get rid of them; they are almost too small to be picked off by the finger, and the operation, too, would be somewhat tedious; an endeavour to blow them off might have just the opposite effect to that intended, and cause them to adhere to the somewhat sticky compound they might be attacking; and altogether it is not surprising that maledictions are often showered on their devoted heads, when they are caught in the act of pilfering.

It is extremely difficult to protect anything from them: they are so small that they will insinuate themselves into the smallest possible openings and crevices, and very little short of hermetical closing is of any avail against them. Should they happen to invade the home of an entomologist, he may well tremble for his treasures, for dead insects are just as acceptable to them as cakes or fruit. I remember having had in my young days several painful experiences of this kind. On one occasion I had just braced out on the setting-board a beautiful specimen of the Wood Leopard Moth (the first of its kind that had fallen to my lot), and had put it aside to dry; on looking at it the next morning I was horrified at discovering that two large holes had been excavated in its great fat body, and that as a cabinet specimen it was ruined; the crowds of tiny red robbers clustered round the insect, and, running over the board, told the tale of the origin of the holes, and many were the corpses that fell as an expiation. On other occasions I have had the bodies of small moths completely eaten up by these destructive little creatures while the specimens were drying on the setting-boards.

Monomorium is not the only foreign ant that has taken up its quarters with us, though by far the commonest. One or two others are found occasionally in hothouses, the high temperature of which serves to remind them of the tropical climate of their native regions.

(To be continued.)

The Lalande-Chaperon Battery.—The Lalande-Chaperon (oxide of copper) battery has been adopted for exchange and line service by the Société Générale des Téléphones of Paris.

Gas at Paris.—The Parisian Company for Lighting and Heating by Gas has announced a dividend at the rate of 30½ per cent. upon its share capital for 1884. The corresponding dividend for 1883 was at the still higher rate of 31 per cent.

SELF-INHUMATION.

A CONTRIBUTION TO HUMAN HIBERNATION.

By Dr. W. Curran.

(*Continued from p.* 217.)

DESCRIBING a *Sanyasi* (an ascetic) named Chandi Churn, who "was in the habit of burying himself alive for three days each week" at one time a Lahore journal—*Public Opinion*—intimates that "the art of prolonging life to an incredible degree without air or nourishment* was not unknown to the ancients"; and Bancroft ascribes many of the wild adventures in which the early Spanish colonisers of Florida engaged to their desire of regaining the vigour of youth in old age through the waters of some fabled well of which they had heard in the interior. However that may have been, expectations of the kind here contemplated were widely entertained in India and elsewhere; and Colonel Steinbach informs us that a certain individual of this (Yogi) class "was covered over and sewn up in waxcloth, like an Egyptian mummy (in the reign of Runjeet Sing). He was then "placed inside a large wooden case, which was strongly riveted down, and sealed in several places with the Maharajah's own seal. This was lowered into a previously made brick vault, and the whole was covered with earth after the manner of an ordinary grave. Corn was sown in this earth, which sprang up during the period of his (the Yogi's) interment; an entire battalion was placed in charge of it (the grave), four sentries mounting guard over it during the day and eight in the night."

At the expiration of forty days he was disinterred, the whole Court being, as before, present; everything was found in precisely the same state as it was left. "On the case being opened, the Sunyasi was found in the same sitting position, apparently lifeless. He was speedily extricated from his covering, and hot bread was applied to his head and feet. His body was also bathed in hot water. After a couple of hours, incredible as it must appear, the Sunyasi not only gave symptoms of returning life, but, in the course of the day, though very feeble, he was perfectly restored." He further adds that "similar experiments were made upon the same individual by two officers in the Bengal Army, and with the like result;" and there exists still in that city a strong belief in the reality of these experiments and in the practicability of this kind of self-imposed sepulture.

This story, or one so like as to be indistinguishable from it, is vouched for or related in almost identical terms by such different writers as old Martin Honighbüger, Lieutenant Boileau, and Captain Osborne. The first of these, who, it may be observed, had peculiar opportunities of knowing the truth from his position as a physician at the Court of Lahore, tells us expressly that "a faquier, named Haridass, was put into a chest in presence of old Runjeet Sing, and buried in a garden outside the city . . . . barley was sown on the ground, and the place was enclosed with a wall and surrounded by sentinels. On the fortieth day, which was the time fixed for his exhumation, a great number of the authorities, with General Ventura and several Englishmen . . . . one of them a medical man, went to the enclosure. The chest was brought up and opened, and the faquier was found in the same position as they had left him, cold and stiff." He was, however, resuscitated in due time, and the Minister, Rajah Dhyan Sing, assured me (he continues) that he himself kept this faquier four months under the ground when he was at Jummoo, in the mountains."*

Of Lieutenant Boileau's "Personal Narrative," which treats of the same topic, I know no more than is said of it in Professor Dowson's edition of Sir H. E. Elliot's "History of India," vol. ii. p. 10, but he appears to have been a spectator as well as a believer in the possibility of such a survival, and the most detailed account of the event—if it be the same—that I have seen is given in "The Court and Camp of Runjeet Sing," by the Hon. W. G. Osborne, Military Secretary to the Earl of Auckland, pp. 125-9, as well as in the attached footnote. From this it would appear that the faquier here referred to "closed with wax his nostrils, ears, and every other orifice through which it was possible for air to enter his body," and that "Runjeet Sing had him dug up twice in the ten months, during which he lay in a state of suspended animation, to relieve his scepticism" about him and his performance. "Captain Wade and others saw him dug up, and was convinced that all animation was suspended. . . . Forcing the coiled up tongue back into its proper place, and pouring a quantity of warm water over him constituted the only further measures (that were required) for his resuscitation; and in two hours' time he was as well as ever."

I may be here permitted to reproduce the following by way of set-off to the above, from a recent writer on the subject who made special inquiries on the point in the country wherein this feat was accomplished, and who had, from his official position and otherwise, access to the very best and most authoritative existing information respecting it. Dr. Norman Chevers spent the best years of his life in India in the investigation of incidents of this description, and his "Manual of Medical Jurisprudence for India" is not only regarded as an authority on questions of medical-police, and practice in the courts of that country, but it has secured for its erudite author the Swinney prize of the Society of Arts, and the esteem of his professional brethren in this. Let us listen to his interpretation of these phenomena. Adverting to these displays as they, or some of them, may have come under his own personal cognisance, and discussing the possibility of survivance on the part of these poor fanatics, he says that "in 1868 in the Purneah district (near Calcutta), a weaver undertook to remain buried during the whole period of a Mahomedan fast. A hole was dug in which he seated himself; a bamboo roof was made over his head, on which earth was piled to the height of about 3 ft. When taken out he was, of course, dead."

"At Bangalore, in 1781, a Yogee, considered by his admirers to be 135 years old, announced that he would be either buried alive, or die in public on a certain day. The police interfered, but he died (all the same), "with strict punctuality." This practice is now, I understand, discountenanced by the police all over India. It is to this interference, doubtless, rather than to any educational improvement or missionary exertion that we owe the comparative infrequency of this observance in these our days, and I notice that the latest performer in this line could receive cheques and other communications from his friends outside.

"At Singapore," continues Dr. Chevers, "a Mahommedan priest secluded himself in a cavity in the ground, covered with boards and earth, but with a hollow

* Describing a race of Indians, evidently the Brahmins, whom he had heard of, Aulus Gellius speaks of them, "Noct. Att.," ix., 4, as "gentum apud extrema Indiæ nullo cibatu vescentem."

* "Thirty-five Years in the East," pp. 127–8.

bamboo communicating with the outer air. On the following morning he was alive. On the second and third mornings no answer was returned, and, on the grave being opened, he was found to be dead." Dr. Chevers justly associates this trick with the religious practice of the Samadh (self-sacrifice), and adds that "if the devotee, being too old and sickly to carry on his usual avocations, is suffocated, well and good—he goes to heaven in a perfectly orthodox manner. If, on the contrary, the bamboo-tube acts successfully, he comes forth to be worshipped and fed for the rest of his life," and the alternative may be worth the risk at our would-be saint's age, and in a country in which the struggle for existence is so keen. Austerities of all kinds, and the more grotesque they are the better, have ever been regarded with reverence and honour in the East, and the self-inflicted tortures of the Stylites and the Anthony's of the Syrian and Soudanese deserts are but continuations of the same spirit and the same practices nearer home.

So many instances of this kind of immunity were brought to light by the forty-days' fast of Dr. Tanner, that, however disposed to doubt the possibility of such occurrences, we ought not to discard them altogether. The evidence adduced above seems to be very strong, if it is not, indeed, absolutely conclusive as to the fact itself, but then we should remember that the European spectators of the occurrence were only strangers in a strange land; that they could not possibly guard against collusion in the case, and that they were obliged to rely exclusively on native testimony and native supervision in connection with it. Runjeet Sing, though a very shrewd and observant man, could neither read nor write: he believed whatever his Guroo chose to tell him, and both he and his courtiers had an interest in elevating and extolling the pretensions of their new creed. This being so, we may, while not absolutely rejecting such stories as fictions, believe that the most was made of them, as well as of the occasion itself, and there would, after all, be but little tissue-waste in such a posture or in such a vault as are here contemplated.

As a matter of fact, many animals and many men do voluntarily reside, for months together, in subterranean recesses of this kind; but then the former are asleep, while the latter partake of food, &c., and in neither case is there such an entire suspension of the animal functions as is assumed in the person of our faquier. It is also curious that these exhibitions have diminished in proportion with the extension of European law and European civilisation in the East, and it is understood that they cannot now be "got up" at all without the usual accessories of a speaking-tube, creature comforts, &c. We are constrained by these and other facts to declare that, though the atmosphere of the East is socially and physically more favourable for the performance of feats of this kind than is our own, yet that the laws of Nature are the same in both, and that while they remain so such acts of endurance as are here described must either be regarded as miraculous, or be relegated, like spiritualism and other "isms" of that ilk, to the regions of illusion or romance.

IT is said that there are in Brooklyn 5,508 telegraph poles, 3,855¾ miles of overhead wires, and 6·21 miles of cables.

FOR the depth of despair in regard to the photographing of children commend us to the operator who, in the recesses of his dark room, after the twentieth attempt to secure the features of an unruly youngster, thus delivered himself:—"Joshua commanded the sun and moon to stand still, and he was obeyed; but I'm hanged if he'd have succeeded with this young imp!"—*Photographic News.*

FIRST STAR LESSONS.

BY RICHARD A. PROCTOR.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*α*, the *Pole Star*).
2. *Draco*, the *Dragon* (*α*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*α*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*α*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*α*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*α*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*α*, *Vega*).
15. *Cygnus*, the *Swan* (*α*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*α*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*α*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*α*, *Regulus*).
24. *Virgo*, the *Virgin* (*α*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*α*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*. the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*α*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*α*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*α*, *Alphard*).
36. *Crater*, the *Cup* (*α*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*α*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*α*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*α*, *Sirius*).
45. *Argo*, the *Ship*.

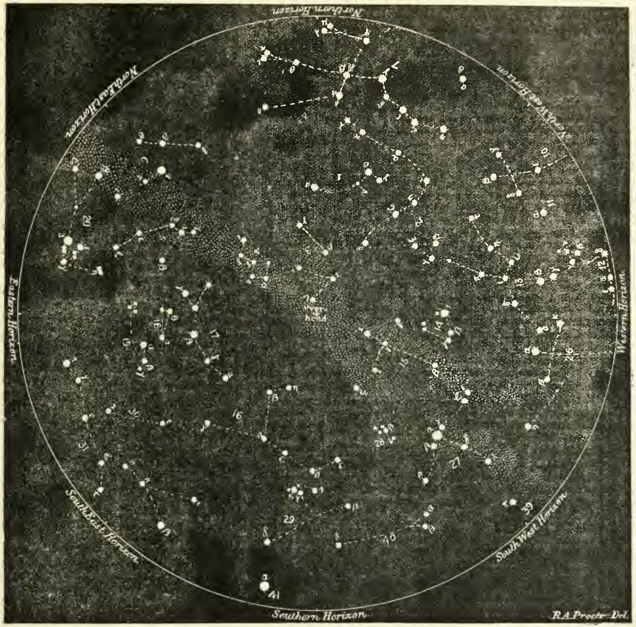
THOUGHT AND LANGUAGE.

BY ADA S. BALLIN.

XVII.

WE have seen that the faculty of imitation is one of the most marked features of humanity in its lowest phases, that it is characteristic alike of the savage, the idiot, the subject of brain-disease, and the infant. Hence, from what we know of the laws of embryology, and the phenomena of reversion to ancestral types, the inference that the earliest men were great imitators seems to be a sound one.

In the light of my previous remarks on gesture language, it is evident that this characteristic must have played an important part in the development of the primeval system or systems of communication between man and man. An involuntary gesture or sound made by A may convey to B a mental grasp of A's situation, and lead B to come to the assistance of A or to render him some service. This being so, when A again finds himself in the same situation, he will voluntarily repeat the same gesture or sound for the purpose of attracting B's attention, and in so doing he has added a stone to the foundation of language. Here be it well understood that language, even in its simplest form, implies the communion of at least two minds—as it were, a giver and a receiver. No solitary being could, or would, form a language, because it would be of no service to him,



NIGHT SKY FOR SEPTEMBER (SECOND MAP OF PAIR),

Showing the heavens as they appear at the following hours:—

At 10 o'clock............September 21.	At 9¼ o'clock.........October 3.	At 8½ o'clock.........October 15.
At 9¾ o'clock.........September 25.	At 9 o'clock.........October 7.	At 8¼ o'clock.........October 22.
At 9½ o'clock.........September 29.	At 8¾ o'clock.........October 11.	At 8 o'clock.........October 26.

although he might make certain marks to serve in after-times to recall ideas to his mind. These marks, on the access of a second person, might become signs to him if a convention were made between the two, and it is, therefore, apparent that convention, which plays so important a part in development of language, is present at its very birth.

Thomson says:—"Language, in its most general acceptation, might be described as a mode of expressing our thoughts by means of motions of the body; it would thus include spoken words, cries, involuntary gestures that indicate the feelings, even painting and sculpture, together with those contrivances which replace speech in situations where it cannot be employed."* Ideas may be communicated not only by sight and hearing, but also by the other senses. Thus Laura Bridgeman, who was both blind and deaf, acquired a good education wholly through the sense of touch, through which alone she could receive instruction. I remember also reading a strikingly illustrative case in which a man, owing to nervous disease, lost all sensation, except on a very small area on one cheek, and his friends managed to make him understand their thoughts and wishes wholly by drawing figures and letters, and otherwise touching this one sensitive spot.

* "Laws of Thought," ed. 1860, p. 27.

In the same way it would be possible to have a language of tastes and smells. As Mr. Tito Pagliardini pointed out many years ago, the language of flowers is made up of colours and scents; and a language of tastes might be similarly constructed. Even now, many ideas are expressed symbolically in what may be called a language of tastes; *sweet* corresponds to the ideas of affection, amiability, pleasantness; *bitter* to unpleasant ideas; we talk of misfortune as the "cup of bitterness," of some persons as "sour-minded," of "honeyed" and of "unctuous" speech, and so on.

Thus, in the absence of sight and hearing, language is still possible, but in their presence it is capable of much higher developments, owing to the greater perfection of the senses. Music is a language in itself—a language expressive of the emotions; but its military uses show that it is not confined to the expression of the emotions, for by its aid orders can be communicated from the chiefs to a number of men beyond the reach of their voices. In a similar way a language of colours and forms is spoken in naval signalling.

For the acquisition of knowledge, especially that knowledge which tends directly to the preservation of the species—knowledge of the approach of a foe or prey, or of a member of the same species, but opposite sex, the senses of sight and hearing are the most important, and it is therefore only to be expected that the development of language should take place in these directions.

We may picture our early fathers talking with their fingers as the ants do with their horns. Pointing to their open mouths to show when they were hungry; pointing to a thicket and indicating, by imitating the sound which it makes, the kind of animal which they wished to kill for dinner, and expected to find hidden there; pointing to the sky and then drooping down the fingers to make known that it was going to rain, an expressive sign used by the deaf-and-dumb; and if they wanted to speak of the wind, stretching out their arms and bringing them together with a rush through the air, perhaps accompanying the action with a vocal sound imitative of that made by air in motion, a sound which has seemingly survived in the Maori word *haruru*, the noise made by the wind, and *hororo*, which is equivalent to English *hurry*, compare, hurricane, rush, dash, swish, and other words imitative of air in motion, or motion through air.

When speaking of the mental condition of the deaf mute it was shown (XIII) that the sign is not only the means of memorising the sensation produced by any object or action, but also represents the object itself. Thus the reproductions of expressive actions, which accompanied certain sensations, stand to mean the objects which produced those sensations, as *hot* (of an oven, teapot, &c.) is represented by the deaf mute by drawing his hand away quickly from the heated object (XI). Similarly, the reproduction of the sound of a fowl is used to mean the bird itself. Imitative or gesture language is a purely descriptive one. Just as ordinary people, when conversing, being sometimes at a loss for a word, are forced to describe their meaning in a roundabout way, so gestures are used by the non-speaking for the expression of thought. A hearing child not knowing the word *box* would say, "Gimme ze sing zat opens and shuts," while a deaf one would imitate the action of opening and shutting the box. If the meaning is not at once clear to the person addressed the speaker, whether in words or signs, endeavours, by further descriptions, to make himself understood.

Although gestures may be made to suffice as a means of communication, they form but a clumsy language at best, for natural signs being to a great extent descriptive, a long series of them is required to express a thought which may be uttered perhaps in one short word.

Up till now I have only spoken of natural signs, but owing to the great principle of least effort, which, in verbal language, is the chief cause of what has been termed phonetic decay, signs may also be abbreviated until they become conventional. A conventional sign is one that is not, like the natural sign, readily understood by those not previously acquainted with it. As an example of such a sign a friend informs me that he was once visiting a German school for the deaf and dumb, and noticed a boy make a sign as if cutting his throat. He asked what was the meaning of this, and was told that the sign meant *Catholic*, because the Catholics had killed the Protestants. Otherwhere a somewhat similar sign was used to mean *pig*, from the mode in which that animal is slaughtered.

The North American traders, in communicating with the Indians, use many conventional signs, which are understood by practice and tradition, for during years of intercourse with the natives natural signs have become abbreviated and changed on the principle of least exertion. In some of these signs it is difficult to trace their natural origin.

Sayce quotes James* as having given a list of 104 signs used by Indians in the place of words, and adding another list by Dunbar, which differs from his own in several respects. According to this, *darkness* was indicated by extending the hands horizontally forwards and back upwards, and passing one over the other so as to touch it once or twice; a *man*, by holding up the finger vertically; *truth*, by pointing with the forefinger from the mouth in a line curving a little upward, the other fingers being closed; *good*, by holding the hand horizontally and describing a horizontal curve outward with the arm; *no* and *not* by waving the hand outwards with the thumb pointed upward. In Dunbar's list, on the contrary, the negative is indicated by holding the hand palm outward before the face, and shaking it to and fro; while *man* is shown by extending the forefinger, the rest of the hand being shut, and drawing a line with it from the pit of the stomach downward.

In monasteries where signs were employed in order not to break the rule of silence, *giving* was shown by opening the hand, *taking* by shutting it. One forefinger laid across the other meant *brother*, *blindness* was indicated by placing the hands over the eyes, *shame* by placing them over the eyes obliquely, *day* and *daylight* by forming a ring with the thumb and finger, and holding them before the face. This gesture seems to refer to the roundness of the sun, which the North American Indians represent by thus forming a circle and holding it up towards the sun's track. They show the time of day by extending the hand towards the east and gradually raising it.

Some of the above signs are natural, as those for giving and taking, and the vertical holding up of one finger to indicate man by the upright position which is one of his chief characteristics. Of others, like that for *day* and *daylight* the natural origin is apparent; but the orgin of others such as those for *good* and *darkness* is very obscure.

LIGHTNING.—On Aug. 20, during a storm, lightning entered a dynamo in the electric-light plant of Erie, Pa., destroying it, and resulting in the extinguishing of all the electric lamps in the streets of the city.

* Long's "Expedition to the Rocky Mountains" (1823), Vol. I., Appendix B, pp. 271-88.

OPTICAL RECREATIONS.

By "A Fellow of the Royal Astronomical Society."

(*Continued from p.* 198.)

RESUMING now our description of polarising apparatus, we may mention that there are two other forms of it which act by refraction, the Nicol's prism and the double-image prism, a very brief description of which must suffice here. The former consists of a long rhombohedron of Iceland spar cut diagonally in a particular direction, and with its cut faces cemented in their original position with Canada balsam after they have been polished. The effect of this arrangement is that a ray of light falling on the prism is split as usual into an ordinary and an extraordinary one. The former is reflected out at the side of the prism by the Canada balsam, and so lost altogether, while the latter passes through and emerges at the opposite face parallel to the incident ray. If light passes through one of these prisms and is viewed at its emersion through a similar one, the rotation of the latter round the ray as an axis will produce phenomena of the alternation of light and darkness identical with those just described in connection with the Tourmaline plates. In all these cases the crystal through which the light first passes is called the polariser; that through which the polarised beam is viewed, the analyser. The double-image prism mentioned above consists of two prisms, one of Iceland spar, cut with its optic axis parallel to its refracting edge, and the other of glass having a refracting angle equal to that of the spar. As the ray, passing through the prism of spar, falls on it perpendicular to its optical axis, the two into which it is divided have the greatest possible separation. The glass prism seems to neutralise the colours produced by the crystal one. In this form the extraordinary ray occupies the middle of the field, and the ordinary ray revolves in a circle round it as the prism rotates round the incident ray as an axis. This is a very handy form of analyser. It has another use altogether, to which we shall have occasion to refer when we come to deal with chromatics by-and-by.

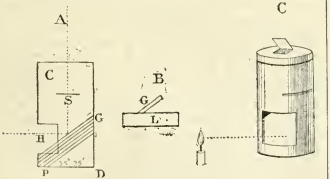


Fig. 49.

So far we have spoken solely of polarisation by refraction, but reflection also is an active agent in its production. In point of fact, almost all (save metallic) bodies polarise the light they reflect, as may be seen by any one who will look at the surfaces of still water, leaves, a polished table or pianoforte, &c., through a plate of Tourmaline or a Nicol's prism. Now it may very well happen that the reader of these lines may, either for economical reasons, or from the fact that he is resident "far from the busy haunts of men" generally, and opticians in particular, be unable to procure either of the simple pieces of apparatus which we have endeavoured to make intelligible. For the benefit of such, we have ourselves constructed a simple—not to say rude—form of apparatus for polarising light by reflection for the purpose of description in this paper, which it needs but the most rudimentary mechanical acquirements to make. Its construction is shown in the figures which follow.

The materials we require are a tin canister with a lid, such as are used to contain mustard, &c, and some thin glass, the "patent plate" used for photographic negatives being very suitable. Our own canister, from which the sketches above were made, held disinfecting-powder before (having carefully cleaned it out) we turned it into a polariscope! Its height is $6\frac{1}{2}$ in., and its diameter $2\frac{1}{4}$ in. It is represented in section at A in Fig. 49, while in B the lid L is shown as being removed. We first cut a hole H $1\frac{1}{2}$ in. high and 2 in. across close to the bottom of the canister, and then facing towards this hole put a bundle of half-a-dozen glass plates, G P, inclined at an angle G P D of 35° 25′ to the bottom P D.

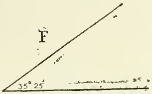


Fig. 50

This angle is shown in Fig. 50, and the reader is recommended to cut it out in cardboard from the figure to assist him in obtaining it correctly. If he wishes to make a *very* neat job, he will describe an ellipse of suitable dimensions (see Vol. V. p. 86) and cut his plates out by this. In the case of the extemporised polariscope, from which our illustrations are derived, the major axis of our plates = 4 in. and the minor axis, of course, $2\frac{1}{4}$ in. The object of tilting our glass plates at this angle is that light is polarised when reflected from glass at an angle of 54° 35′ from the perpendicular, and as the angles of incidence and reflection are identical (Vol. V. p. 390), a horizontal ray entering at H must strike the surface P G at an angle of 35° 25′ with it or 54° 35′ with a perpendicular to it, and of course be reflected up the tube at a similar angle on the other side of the perpendicular. Now out of the lid L we cut a frame, and into this fix another piece of our glass, which we this time smoke or otherwise blacken at the back. By the way, before fixing the glass, we cut slits S in the side of the can, the use of which will be apparent later. We must, by the aid of our piece of card (Fig. 50), take care that our small mirror on the lid forms an angle of 35° 25′ with the top of it. Putting on the lid, our apparatus is now complete, as seen at C in Fig. 49. If we place a candle in front of the opening at the bottom of the tube, with the mirrors in the position shown by our figure, and bring the eye into a suitable position, we shall see the image of the flame reflected from the blackened mirror in the lid; but if we turn the lid round through an angle of 90°, the candle image in this mirror will get very dim indeed, even should it not entirely vanish. If we continue the rotation of the lid, the image will grow brighter and brighter, attaining its maximum brightness when the top and bottom mirrors are parallel, and will once more disappear when the lid has rotated through 270°, to return to its pristine light on the completion of a whole revolution. Hence it is evident that the light is polarised—or its vibrations are all turned into one plane—by the first reflection from G P, and that the second mirror acts as an analyser. It may not be uninteresting to note here that the discovery of the polarisation of light by reflection was made in the year 1810 by Colonel Malus, of the French Engineers, who

looking through a prism of Iceland spar at the sunset light reflected from the windows of the Luxembourg Palace, noted its disappearance and reappearance as he rotated his prism.

(*To be continued.*)

THE RIGHT WHALE OF THE NORTH ATLANTIC.

As every one knows, right whales were once very common in the Gulf of Gascony, the dwellers along which, in France as well as in Spain, appear to have been the first Europeans to raise the fishery of these monsters of the deep to the rank of a great industry. Upon the coast of Cantabria are still to be seen the ruins of the towers where watchers were stationed to give notice of the approach of the numerous whales that visited these shores during winter, and the remains of the furnaces where the fat was melted. Official documents and royal edicts of the twelfth and thirteenth centuries speak of the whale fishery as an already ancient industry. The majority of the cities of the Spanish coast – Fontarabia, Guetaria, Motrice, &c.—have figures of whales or of fishing implements on their coat-of-arms.

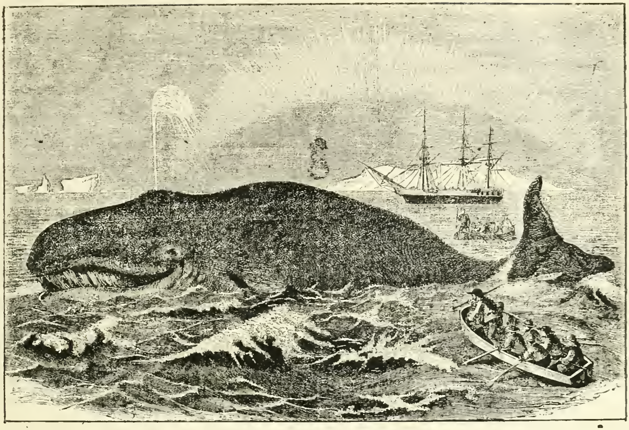
The Basques were soon no longer content to fish for whales on their coasts, where they were becoming scarcer and scarcer, but pursued them into the English Channel and North Sea, and as far as to Iceland. Later on, at the close of the fourteenth century, they did not hesitate to sail out upon the broad sea toward the quarter where Cabot, a hundred years afterward, discovered Newfoundland, and where they found the cetacean very abundant during the summer months. Their success made rivals for them, and in 1578 there were, on this part of the ocean, three hundred ships—French, Spanish, Portuguese, and English.

Fishing upon the high sea is scarcely applicable to any but the sperm and true whales—those whose back is even, finless, and without a hump—the "right whales" of fishermen (*Balæna*, L.; *Eubalæna*, Gray; *Leiobalæna*, Eschricht). The other cetaceans—the "finbacks" and "humpbacks" of fishermen, and *Balenoptera* and *Megaptera* of naturalists—almost always sink when killed, and are thus lost to the captors unless they are driven into a bay, where the carcass, upon making its appearance on the surface in a few days, can be towed to the shore and cut up. It is very probable, then, that the cetaceans that the old Basques fished for were sperm and right whales, and especially the latter, which were much commoner than the former in temperate or cold water.

As a consequence of the war against it, the whale became more and more rare. In the seventeenth century the seas in the vicinity of the pole, where navigators in search of a north-east passage to India had sighted a large number of the animals, which were remarkable for their gigantic size, became the scene of the fishery. A century later, the scene shifted to Baffin's Bay. Did these whales and those that were formerly fished for n the temperate part of the Atlantic belong to the same species? Upon the authority of Cuvier, when cetology was scarcely beginning to get out of its swaddling-clothes, zoologists answered in the affirmative, giving as the reason why whales were no longer found in the temperate zone that they had taken refuge amid the ice of the poles in order to hide themselves from pursuit! This is a gross error, which was perpetuated for a long time, which is still found repeated in many books, and which has been committed not only concerning the right whales of the North Atlantic, but also the various species of true whales distributed through the different oceans. The same causes have everywhere produced the same effects—the almost entire disappearance of the large, utilisable cetaceans. No longer than thirty years ago the whaling industry still occupied whole fleets; and the Americans, who had almost the entire monopoly of it, repeated with pride that their whaling vessels placed in a line in sight of one another, would occupy more than half of a great circle of the globe. In 1856 they still had 655 ships on the sea, but to-day the industry is almost completely abandoned for lack of whales. Fishing is no longer done except by a few rare ships from the ports of Scotland, that go out to the Polar Sea for seals, and fish for whales incidentally. In the large seas of the temperate zones, the South Atlantic, the Pacific, and the Indian Ocean, where fifty years ago a load of oil was obtained in a very short time, whales are now so rare that it may almost be said that there are none. It has been said that the whales of these seas fled towards the poles in order to escape man; but it is now well ascertained that the different species of right whales are quartered in spaces in which they accomplish, according to the season, periodical navigations that are necessitated by need of food and the parturition of the females, and which their organisation does not permit them to leave. If no more of them are found, it is simply because they have been destroyed. Moreover, the frosts of the poles have proved no more of a barrier to whalemen than the heat of the tropics; every corner of the globe has been explored whither ships could venture, even at the risk of a thousand dangers. Just as soon as a new field was made known as productive, everybody flocked thither, and it was soon exhausted—a result that is explicable without recourse to the theory of flights or migrations *en masse*.

While regarding the polar whale, *Balæna mysticetus*, L.) as the same as was formerly fished for in the temperate North Atlantic, naturalists (Cuvier among them) catalogued, under the name of *B. glacialis*, another species which differed from *B. mysticetus* in its much smaller size, its slenderer body, its much smaller head, and its shorter mouth-plates ("whale-bone"), and which inhabited the shores of Iceland and Norway. The Icelanders called it *Sletbak*, the Dutch, *Nordkaper*, and the French, *Sarde*—a name that the Basques gave to the whale of the Gulf of Gascony. It is astonishing that this name did not attract the attention of naturalists, and that they did not ask whether the *Sletbak* of the Icelanders, the *Nordkaper* of the Dutch, and the *Sarde* of the Basques was the same animal. A discussion of the old fishery narratives and of documents derived from the Dutch and Norsmen answers yes. A Norse MS. of the twelfth century, the *Royal Mirror*, teaches us that the Icelanders fished in the entire North Atlantic, and they perfectly distinguished *two* species of right whales—one at the north and the other at the south. They knew besides that these animals never frequented the same waters, and that the northerly limit of the one was the southerly limit of the other.

If representatives of the southern species remained, they must have been very rare, for one could traverse and retraverse the North Atlantic without meeting a single one of them. The case is cited of a right whale stranded upon Re Island, in February, 1680, and in 1783 a whaleman harpooned one between this island and Newfoundland. Cod fishermen have spoken much



The Right Whale of the North Atlantic.

of whales in the vicinity of this island, but science has not pronounced upon it. The whale of the Basques was regarded as extinct, when, on the 14th January, 1854, a specimen, accompanied by a calf, showed itself opposite San Sebastian. The mother succeeded in escaping, but the calf was captured. Its external form and a study of its skeleton convinced Eschricht that it belonged to a peculiar species, differing completely from *B. mysticetus*—hence the apellation *B. Biscayensis*, introduced by him into the nomenclature.

Five Balenidæ, either stranded or captured upon the Atlantic coast of the United States between 1862 and 1883, and considered at first by Prof. Cope as belonging to a new species (*B. cisarctica*), have been found to differ in nowise from the San Sebastian specimen.

The cetaceans that were called *φαλαιναι* by the Greeks and *balænæ* by the Romans were doubtless large balænoptera that entered the Mediterranean, and, perhaps, also sperm whales (which are sometimes met therein), and not right whales, since these do not seem to have ever frequented this sea, at least regularly. At all events, their presence there had never been authentically announced since historic times until February 9, 1877, when, to the great joy of cetologists, a female was captured in the Bay of Taranto. The length of this was about forty feet. Its relatively slender form, the small size of its head (one-fifth the length of its body), and the shortness of its mouth-plates (numbering 240 on each side), the largest of which was only thirty inches, its falcate pectorals, and its black colour separated it widely from *B. mysticetus*. Its stomach was entirely empty, and it appeared to have suffered from a long fast. In consequence of this peculiarity, and from its resemblance to the whales of the southern hemisphere, Prof. Capellini, of Bologna, believed that it came from this latter region. To him it was, perhaps, a representative of the Indian Ocean species, one nearly unknown to naturalists, and one that no European museum had the remains of.

Among other objections to this manner of viewing it, there is one that is very important, viz., it has been well proved that the right whale never passes from one side of the equator to the other, this being for it like a circle of insuperable fire, and that, except in very rare cases, it even keeps outside of the tropics. It was more natural to see in the Taranto whale a North Atlantic species that had strayed into the Mediterranean, and this was proved by a comparison with the San Sebastian calf and other skeletons, and by a very complete study by Prof. F. Gasco. According to the latter, the animal could not have been more than three or four years old, judging by its size, and assuming that the female of *B. biscayensis* (as shown by several examples) was fifty feet in length. A female of this size, taken by the harpoon off the coast of New Jersey, was towed to New York in the spring of 1882. This also had a wholly black body. From the figure of it given in the *Bulletin* of the American Museum of Natural History (May 1, 1883), it appears to have been more massive than the Taranto specimen. This relative heaviness is, perhaps, attributable to a difference of age between the two individuals. In short, compared with known examples, it does not exceed the limits of individual variation. Thus the whale of the Basques (*Sarde, Nordkaper, Sletbak, Balæna biscayensis*, Esch., *B. cisarctica*, Cope) still exists, although represented,

it is true, by a small number of individuals. It inhabits the North Atlantic, and in winter frequents the coasts of Europe, and in summer those of North America, where probably the females are delivered. Iceland is its northerly limit. It appears nearly certain that its migrations take place entirely along the course of the Gulf Stream.

For some time past the number of individuals has sufficiently increased on the coasts of South Carolina and Georgia to make it an object to fit out vessels for capturing them, and the operations of these have given results that are satisfactory to the eyes of the promoters, but deplorable to those of naturalists. As its restoration has been nipped in the bud, will not the species for ever disappear ?—H. Jonan, *in "Science et Nature."*

Gossip.

By Richard A. Proctor.

The following illustrates Burns's "O wad some pow'r the giftie gie us, To see oursels as others see us ! " :—

"The Edinburgh Reviewer of Spencer's 'First Principles,' in January, 1884, thinks that something like the following must have been omitted at the end of the column on unconscious mistakes in writing and proof-correcting, at p. 253, last week" :—"'Yet I myself, last year, first charged the reviewer of a pet of mine with intentionally making nonsense of a quotation by omitting one of two lines which both ended with the same four words ; and then, when I confessed that I ought not to have said that, I added that he could not be acquitted of gross carelessness in passing over such a mistake in the proofs—or words to that effect. I suppose I found the temptation to dispose of a whole article in the *Edinburgh* by one good kick irresistible, and then I had to let myself down easy when I saw that first kick would not do. I never write hastily, as I was once accused of doing.'"

Here we certainly have a curious illustration of unconscious cerebration either by my correspondent or by myself ; for if he is right, then in the interval which has elapsed since the events above referred to took place, my mind, unconsciously modifying them, I suppose, has presented them to me in a very different aspect. My recollection presents the matter as follows :—To begin with, I by no means charged, or even thought of charging, the *Edinburgh Reviewer*, with intentionally making nonsense of a quotation by omitting two lines. My impression after reading the review was that a strong sense of dislike of Mr. Herbert Spencer's doctrines, had so far influenced the mind of the reviewer, that he had not been careful to understand fully what Mr. Spencers doctrine's were. I know how it is myself in such cases. Having once adopted the idea that a writer's views are utterly incorrect, I should be apt to misread and misjudge any work of that writer's across which I might afterwards come.

Here is a case in point,—my friend Mr. Neison, in letters to me had shown such want of knowledge about elementary mathematical matters that I had (justly, be it noticed) learned to regard his opinion on such things as not likely to be correct. A short time after, he published his excellent book on the "Moon," in which calculations of a more or less abstruse character were introduced or referred to as of his own making. I was so possessed with the notion (originally correct) that Mr. Neison was unable to conduct such inquiries correctly, and so far from imagining that he had in the meantime got through work and study which would fairly have occupied thrice the time, that—with the fairest *intentions*—I misjudged his work, and wrote of it unfairly and unjustly.

I may cite another case where I am myself interested, but in another way. I wrote a fortnight or so ago an article on the "New Star in Andromeda" for the *Times*, which appeared with a promptitude implying that it had pleased the Editor (I did not even have a proof of it). When I read it myself, I was satisfied with it, as it seemed to me at once correct and compact, as well as happily worded and (I thought) effective. I was confirmed in the belief that it was not bad, by letters from friends who had recognised it as mine, and one letter from a friend who had always carefully refrained from expressing an opinion about my writings, but who on this occasion said he had been moved to do so, as he thought it my best bit of work yet, or words to that effect. While I was thus being led to view the article somewhat complacently (it appeared in last week's Knowledge chiefly because of these expressions of opinion), I received a letter from a much-regarded friend, whose opinion has always been of great weight with me, in which the article was casually referred to as obviously by So-and-So (So-and-So being a person he loves not), with the comment—"He can write more unparalleled rot about astronomy than any living man." On this, considerably tickled—though I felt that if my friend had known the article was mine, and had found it atrocious, he would have been heartily grieved to have seen bad work from me—I wrote to another friend, equally valued, who had recognised the article as obviously mine, asking him for his frank opinion. His judgment went with those who liked the article. He specially dwelt on the correct and concise yet clear way in which astronomical facts were, in his opinion, presented. Hence, though not necessarily regarding the article as quite so satisfactory as I had at first considered it, I attribute its appearing as "unparalleled rot" to my friend as the effect of his preconceived opinion that it was written by a person who usually does write considerable nonsense about astronomy,—this opinion being based on external evidence. Certainly it was most unlikely that I, being in Scarborough, on Saturday when the news appeared (in the *Times*) to which my article referred, and having, as my friend knew, much literary and lecturing work on hand, should have found time to write an article to appear in the *Times* of Tuesday. Therefore, I think my friend did not read that article very carefully, especially as there were some passages in it which Mr. So-and-So would never have written,—while the closing paragraph presents the precise views, maintained hitherto (with the same fulness) by no other, which I had presented at the close of my lecture on "Star Clouds, Star Mist, and Star Drift," at the Royal Institution, in 1870.

I judged that the *Edinburgh Reviewer*, one of the friends I esteem and value most, had read "First Principles" with a feeling of prejudice which had prevented his recognising the real value of Mr. Spencer's philosophy. With this feeling, he might readily have so misunderstood the passage which was accidentally garbled, as not to recognise the importance of the omitted words. Their omission certainly made nonsense of the passage ; and therefore there was some degree of carelessness in overlooking the printers' mistake. If the

reviewer had really grasped Mr. Spencer's meaning, and had been considering that meaning when correcting proof, he could not have overlooked the mistake. But, I am as sure as I am of my own existence, that I did not use the words "gross carelessness" or words to that effect, knowing as I do that my remarks on the review were written with a strong feeling of regret that a friend whom I esteem and whose powers I admire, should so misinterpret and undervalue the philosopher whose doctrine has been worth more to me and to many others than that of any teacher who has drawn the breath of life.

If my friend thinks that in describing my own mistakes I intended to acquit myself of "carelessness,"—as he implies by using the word "yet" in the remarks he imagines me making—he is quite mistaken. A blunder is a blunder, explain it how one may: my mistake in "Saturn" would not have been made if I had kept my attention alive, and would have been corrected if I had gone a second or third time over all my marginal directions to the printers. So with the curious blunder repeated page after page in my "Transits of Venus" (First Edition). I ought to have detected and corrected it.

It has not been to acquit myself of carelessness, but to show how readily mistakes may be made, and how abundantly precautions should be used in writing and correcting what one has written, that I described my own experience. I believe a man may derive useful lessons from his mistakes. And if his experience happens to be exceptional (as my experience in scientific writing has been) he may do good service by communicating such lessons to others.

I believe, too, that it is useful to show by example, as well as to inculcate by precept, the advantage of a little frankness in admitting mistakes. Prof. Sylvester, the mathematician, once laid down in *Nature* the principle, as his in practice, that when any one has pointed out an error or what he supposes to be an error in another's writing or teaching, the passage so dealt with should either be silently corrected or silently maintained. I reject this principle as unworthy of the true student of science. If any man, no matter what his standing or position may be—were it even Mr. John Hampden—points out an error in anything I have written, I mean to acknowledge openly that he is right and that I have blundered. Where any man points out what he deems an error, but what I either know or believe to be right, I do not undertake to maintain my position by argument (for all men cannot understand reasoning), but I mean in such cases to state openly that in my judgment my original statement was sound and just.

The idea that there is dignity in silence in such cases, I regard as absurd. There is no more dignity in such silence than there is in the silent tenacity of the bull-dog, or of the Tasmanian Devil. Though animal comparisons are not always satisfactory, one may in this case say that the animal which remains silent till he sees his way to a grip, is a less generous and a less dignified creature than the animal who frankly announces his opinion, even though it be by a roar. Silence is fit company for Treachery or for Dishonesty, not for Truth.

It has been said that controversy is *always* degrading. It always is where on either side, or on both sides, it is maintained with any other object but to get at the truth. So also controversy is always idle, when one or other is unable to understand his opponent. This applies even where both are eminent and able. For example a controversy between a Newton and a Shakespeare about astronomy or about the drama would be idle, as would a controversy between a Handel and a Huxley about music or about the Eohippus. A controversy, again, between Mr. Mattieu Williams and myself about the manufacture of iron or about coal-mining would be idle; because he knows much and I know little about those subjects: and, in like manner, a controvery between him and me about geometrical optics (as about the "Ruddy Eclipsed Moon") could be but of little use.

The controversy between Messrs. Herbert Spencer and Frederick Harrison about the Unknowable was another case in point, for the latter never understood even what it was about,—as he showed by his every argument and his every suggestion. Yet controversy between men who know their subject, and who wish to learn if possible the truth, is neither idle nor degrading, but very much the reverse of both.

In passing, I may note that, whatever my regard for Mr. Spencer's philosophy may be, whatever the debt of gratitude I personally owe to him for the meaning and the value which his philosophy have given to my life, it cannot be said that I have been blindly ready to accept all he has taught. I have rejected as unsound the nebular hypothesis of Laplace, which Mr. Spencer values; I have, in these columns, pointed out the objections which, in my opinion, invalidate the theory that the minor planets are the fragments of an exploded world—a theory which Mr. Spencer has advocated; and in the very discussion with my friend, the "Edinburgh Reviewer," I dwelt strongly on a view respecting the Laws of Motion which, to say the least, is not that maintained by Mr. Spencer. It is therefore as no mere disciple, following him in all he teaches, that I have expressed my sense of the value of his philosophy. Of this I might say, were not the words likely to be misapprehended, that with many for years it has been a religion. As a philosophy, I hold it worthier of the dignity of reasoning man—at once clearer and profounder, kinder and more considerate, braver in upholding right and resisting injustice, and better calculated if steadily followed—to make men happier and better, than any which hitherto has been propounded to the world.

I find from several letters that my remarks about our public schools in a recent number have been very much misunderstood. I was there speaking entirely of the system of fagging, and its associated bullying and sneaking. In some schools fagging does not exist, but bullying and sneaking do; in others, fagging exists but bullying and sneaking are kept sternly down. Yet fagging unquestionably encourages both. The system is a curious relic of old times, when the public schools were utterly unlike what they are now. Every trace of it ought long since to have been swept away. No harm may in individual cases arise from it; but in many instance it affords direct incentives to meanness on the one hand and to bullying on the other.

Of course I know that, as many correspondents point out, our public schools have done excellent work—despite, however, not because, of those absurdities of

system which are so obstinately maintained. Under a strong and manly head-master, with a well-chosen staff, a public school even where the fagging system is in full swing, becomes a place where bullying must be done in secret and where meanness hides its head ashamed. But unfortunately not all head-masters are strong and resolute.

I feel bound, in justice to Mr. Mattieu Williams, to state that he has explained to me his idea that I had adopted, or accepted, his doctrine of the heated condition of the giant planets [without one word of acknowledgment]. He had not seen any earlier reference to that view in my books than in an essay of mine published in 1872, whereas the first edition of his "Fuel of the Sun" appeared in 1870. I have explained to him, in turn, that the theory is maintained in the first edition of my "Other Worlds," written in 1869, and published early in 1870. This was preceded by my lectures at the Royal Institution, Manchester, in November and December, 1869, wherein the same views were presented. I have no doubt that the Syllabus of the series is still obtainable. In saying this, I am not at all anxious about priority being assigned to me. The general idea was Buffon's, as I have always been careful to explain. What I objected to was being pointed to as one who could be guilty of the meanness of presenting another man's theory as his own, and by omitting all reference to the real author. I should not care to deserve such contempt as I feel for any one capable of doing this.

What an odd mistake that *experte credo* of mine, for *experto crede* was! It was not so far from my meaning—after all—though a sheer accident (whether of printers' or of mine own I know not).

Here is a rather odd coincidence. In *Truth*, for Aug. 27th, the following little paragraph (intended, I make no doubt, for truth, but there is little truth, in truth, in this paragraph in *Truth*) appeared :—

> Since the Deluge, life has not been long enough for long whist, except for maiden ladies wintering in watering-places. But now short whist is threatened, since in Mr. Proctor's hands it has become so painfully scientific as to be no longer a pastime. Mr. Proctor could only find one decent player in America, nor is he confident about that one. This speaks well for the comfort of life in the States; for there is but one individual who is more intolerable than the bad player, and that is the man who plays well and criticises his partner.

On the self-same day, the following paragraph from my pen appeared in Knowledge :—

> "Cavendish" and his school seem determined to prove that those are mistaken who have said of Whist, "Age cannot wither nor custom stale its infinite variety"; for they try to substitute a series of cut-and-dried Cavendish rules for that beautiful variety which is the charm of the game. If Whist developments as developed in this book are adopted by Whist players generally, then Whist will no longer be a game. It may be a mental exercise, just as walking along a pavement is bodily exercise; but there will be no game in it.

Of course, I have never said I could only find one decent player in America. On the contrary, I said in the *New York Tribune*, that, in the only sitting I ever had in New York I had met with several excellent players. That these players showed severally a fault or two of style did not prevent their being good players. I mentioned (in the *New York Tribune* also) that the best of them had the habit of holding up his Ace when King was led by an opponent from King, Queen, and others. It may seem, to those who do not know the game, very "painfully scientific" to point out that this is bad play; but there can be no doubt it is so. "Cavendish" says, "It is seldom good play," which certainly means that to do it systematically is bad play. But a man who has this bad habit may be a fine player, all the same.

I am at any rate free from one of the faults condemned —very justly—in *Truth*. I do not have enough practice to play well, or at any rate to my own satisfaction; but, whether or no, I *never* criticise a partner, or express an opinion on the play unless asked to. I think I may truthfully say that I have never at the whist table said one word at which any player present has even been disposed to take exception.

The logic of the last sentence quoted from *Truth* is rather odd. *Truth* seemingly says that if all players, except in America, are bad, life in America must be very comfortable; for there is scarcely any one (only in fact just one person) more intolerable than the bad whist-player.

A correspondent asks whether the reviewer was not mistaken who said recently in these columns that Mr. Mivart was a believer in evolution: had not Mr. Mivart opposed Darwin's theory? Both statements are right. Mr. Mivart has opposed the theory of natural selection; and Mr. Mivart is a believer in the doctrine of evolution.

Another correspondent calls my attention to the perfectly preposterous article about the "New Star" which recently appeared in the *Daily Telegraph*,—in which the idea that the new star is a new world is dealt with as the true scientific teaching. It is absurd—but did not Prof. Pritchard write in *Good Words* of the new star in Corona, in 1866, as a "World in Flames"? I should say that for one person who knows that no star is a world—let it be what else it may—there are ten who think the stars are *all* worlds. Let not any one be so evil-disposed as to suggest here that probably ever star is a whirled body.

The following remarks appear in the London correspondence of several county papers :—

> The astronomers are discussing whether or not the "new star" in the Andromeda nebula has changed since it made its appearance two or three weeks ago. They write of the process as "now going on," forgetful of the astronomical theory that the light of the "new star" must have taken thousands of years to reach us. This theory is propounded in every book on astronomy. Have Mr. Proctor and the other astronomers forgotten it, or can it be that they reject the orthodox notion that the changes in the new star are not taking place now, but took place a few thousand years ago? A correspondent has already raised this interesting point, but so far no answer is forthcoming.

It is hardly necessary for me to remind readers of Knowledge that in my article about this star (Sept. 11) I dealt with the time question. Probably a hundred years ago would be nearer the mark though than thousands of years ago.

The following is from my "Popular Science Column" in the *Newcastle Weekly Chronicle*:—"My friend and near kinsman, Mr. Thomas Foster, wrote a paper making fun of the modern fashion of finding nature myths in every ancient story, from the story of Adam and Eve down to that of Cinderella and the glass shoe. In this paper Mr. Foster suggested that the poem beginning, 'Hey diddle diddle, the cat and the fiddle, the cow jumped over the moon,' related in all probability to a long since forgotten nature myth. He connected the

opening words 'Hey diddle diddle'—through the equally mysterious 'deedle deedle dumpkin'—with the Humpty Dumpty who sat on a wall,—undoubtedly the setting sun, Endymion, just as 'Hickamore Hackamore on the King's kitchen floor' is the sun in full glory in the heavens: with much more nonsense of the same sort. (He will forgive me for so saying, having *intended* nonsense.) Now, does not a writer in the *Belgravia Magazine* gravely tell us that the legend of 'Hey diddle diddle, the cat and the fiddle,' related unquestionably to a nature myth, and in all seriousness assure us, as Foster had laughingly said before, that the cow jumping over the moon, the little dog, &c., are astronomical references? Truly Thackeray must have had this joke in his thoughts when he wrote the lines—

> Qualia prospiciens catulus ferit æthera risu
> Ipsaque trans lunæ Cornua vacca salit."

THE FACE OF THE SKY.

FROM SEPT. 25 TO OCT. 9.

BY F.R.A.S.

NO opportunity should be neglected of observing the Sun for spots, faculæ, &c. The face of the night sky is shown on Map X. of "The Stars in their Seasons." Possessors of telescopes, large or small, will, of course, scrutinise the new star in the Great Nebula 31 M. Andromedæ on every available occasion. There will be minima of Algol on Sept. 29, at 11h. 46m. p.m., and on October 2 at 8h. 34m. p.m. Mercury is a morning star during the next fortnight, but is approaching the sun daily. He may, however, be caught over the eastern horizon before sunrise. The Zodiacal light, by the way, may be observed in the same region now. Venus is an evening star, and may be seen in the west after sunset, though she is but an indifferent object in the telescope, presenting only a comparatively small gibbous disc. Mars, Jupiter, and Uranus are all invisible during the hours during which the amateur generally works. Saturn in Gemini rises soon after ten o'clock to night, and about 9h. 11m. p.m. fourteen days hence, whence it will be seen that he is fairly visible by midnight. Neptune rises a little before 7h. 30m. to-night, and, of course, sooner and sooner on each succeeding one. The Moon enters her last quarter 30·9m. before noon on October 1, and is new at 7h. 31·4m. a.m. on the 8th. During the fourteen days over which our Notes extend, she will occult five stars. To begin with to-night, μ Piscium, a star of the 5th magnitude, will disappear at the Moon's bright limb at 8h. 12m., at an angle from her vertex of 94°. It will reappear at her dark limb at 9h. 9m. p.m., at an angle of 233° from her vertex. On Sept. 26, B.A.C. 741, a $6\frac{1}{2}$ magnitude star will disappear at the bright limb at 9h. 19m. p.m., at a vertical angle of 26°; to reappear at the dark limb at 10h. 3m. p.m., at an angle of 299° from the vertex of the Moon. On the 28th 48 Tauri, a star of the 6th magnitude, will disappear at the bright limb at 9h. 56m. p m. at an angle of 33° from the Moon's vertex, reappearing at her dark limb at 10h. 45m. p.m. at a vertical angle of 273°. Later on the same night the 4th magnitude star γ Tauri will disappear at the bright limb at 11h. 46m. at a vertical angle of 36°, and will reappear at the dark limb at 12h. 43m. at an angle from the vertex of the Moon of 279°. Lastly on October 1 λ Geminorum, of the $3\frac{1}{2}$ magnitude, will disappear at the bright limb 38 minutes after midnight, at a vertical angle of 30°, reappearing at the dark limb at 1h. 32m. the next morning at an angle from the Moon's vertex of 248° We have said that five stars will be occulted by the Moon during our specified period. There will however in addition be a daylight occultation of Aldebaran at 8h. 33m, a.m. on September 29 at an angle of 173° from the vertex of the Moon, but an equatorially-mounted telescope will be needed to find the star. It will reappear at 9h 19·3m. a.m. at a vertical angle of 319°. The Moon to-day is in Pisces, but at 10 o'clock to-morrow morning passes into the North-West corner of Cetus. By 7 p.m. she has crossed this and entered Aries, which she quits in turn at 1h. 30m. a.m. on the 28th for Taurus Travelling right across this constellation she, at 3 p.m. on the 30th, arrives at the narrow northern strip of Orion. Passing over this in about twelve hours she, at 3 a.m. on October 1, emerges in Gemini. Through this she travels until 4 p.m on the 2nd, when she moves into Cancer. She quits Cancer in turn for Leo at 5 a.m. on the 4th. In her passage through Leo she, at 1 p.m. on the 5th, descends into Sextans, to re-emerge, though, in Leo at 7 p.m. She finally quits Leo for Virgo at 6 p.m. on the 6th. Her passage through Virgo occupies until 7 p.m. on October 9, when she enters Libra. We there leave her.

TO CORRESPONDENTS

"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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ON THE FOOT CLOTHING OF PRIMITIVE PEOPLES.

[1935]—The reformers of ladies' dress do not seem hitherto to have turned their attention to all the evils attendant on the modern form of foot covering and the materials of which it is made.

Professor Mattieu Williams, in his XVIth article, objects to the stiff leather shoe or boot as being both uncomfortable and prejudicial to health; but he does not give any hint as to what he would recommend as a substitute. He acknowledges that bare feet are objectionable in view of tin-tacks, broken needles, &c. He does not allude to the fashion of wearing high-heeled boots—a custom most fatal to beauty of form in the human foot. If we look around us (so widespread has the custom become) we can with difficulty find any young women of twenty-five, or thereabouts, whose feet are not permanently disfigured, if not deformed, by this practice. From the heel of the foot being lifted out of its natural position, and thus not receiving its due proportion of the weight of the body, there is undue pressure on the ball of the great toe, the front part of the foot is widened, the great-toe joint enlarged, and the foot thus rendered most unsightly.

Prehistoric and primitive peoples were—and certain races who still adhere to their ancient customs are—much wiser in such respects than those who have adopted modern civilization, and study fashion before comfort or convenience, regardless of its results.

Let us now consider the nature of the foot-coverings adopted in ancient times, and note their survival amongst certain peoples who still follow the mode handed down by custom and tradition. Those who originally adopted it, found it was that which best suited their needs. We have drifted very far away from the original type of shoe worn by prehistoric and aboriginal races; but as in art we have found ourselves compelled to go back to the pre-Raphaelite school to regain what has been lost in the succeeding centuries, so even in shoe-leather and in the form of our shoes, we may, perhaps with advantage, make a fresh start from the ancient models.

Specimens of foot-coverings belonging to the Ancient Britons may still be seen in our museums. They consisted of a piece of raw or moistened hide dried on the foot itself, cut to the required shape, and kept in position by thongs of hide or pieces of string. Such shoes are still worn by the peasants and shepherds of the Roman Campagna, and also by the inhabitants of the Orkney and Shetland Isles, where they are called Rivilins. This is probably the oldest form of shoe known. I have seen a similar kind in use on the borders of Central Asia.

In Ladakh, or Western Tibet (Leh, the capital of this province, is 11,500 ft. above the sea-level), the climate is, during the greater part of the year, a most inclement one. The natives protect the leg and foot with a sort of rude stocking made of thick puttoo, a woollen material of home manufacture: a piece of untanned hide, as described above, is fitted to the foot, and cut round to about the height of an ordinary shoe; it is then stitched fast to this primitive form of stocking, which is made wide and comfortable. In the cold weather, when a Ladakhi goes on a journey, he fills up the interstices in his stockings with flour, thus protecting his feet from the frost, and also having an additional supply of food with him in case of necessity.

It may be objected that Ladakh is an almost rainless country; but yet, if this form of shoe were not a good one, the practical Scotch peasant would surely have discontinued the use of his Rivilins.

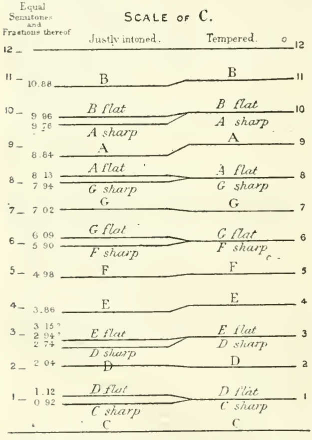
The Kashmiris (except those of the very lowest class) wear a kind of sandal made of tanned leather, resembling what we call the Roman sandal, over a kind of low boot made of fine thin leather, and very loose and easy. Some wear beneath this, again, a kind of sock or stocking; but the very poorest, both in Kashmir and in the Lahort Valley in the Himalayas, wear sandals made of grass or of rice straw, which, when they are on a journey, last at most two or three days, but are quickly replaced by another pair, which the wearer either makes himself or purchases at a cost of about one penny. The paths leading to some of their favourite places of pilgrimage are strewn with such discarded sandals.

In the Anglo-Saxon department of the British Museum are leather sandals, or rather fragments of them, which are similar in character to those now worn by the upper and middle classes in Kashmir. Why should we not endeavour to work on these lines?

The grass sandals we could not reproduce, neither would they be suitable to our climate; but in the course of a month or two, when I expect to return to England, I will endeavour to have a pair of sandals made, similar to those which I brought from Kashmir a few years ago, and send them to the editor of KNOWLEDGE to be exhibited by him, or sent to Prof. Mattieu Williams, or to any one who is likely to take up the idea and make such rational foot-covering *the fashion*; for, unless this can be accomplished, no amount of preaching or teaching will have an effect upon either shoemakers or their customers. COSMOPOLITAN.

MUSICAL TEMPERAMENT.

[1936]—I send a diagram of a comparative view of just intonation and equal temperament: the form new, the substance borrowed from Mr. Ellis's Additions, Appendix XIX., to Helmholst's "Sensations of tone," &c.



Mr. Ellis has recently introduced the term "cent." as a measure of musical intervals; it means an hundredth part of a semitone—1,200 cents. go to an octave. He says (when two notes are sounded at once) two cents. "make a distinct difference in consonances, and five cents. are felt to be out of tune" (see "Journal Soc. Arts," March 27 of this year). In the present diagram the consonance of the fifth CG is shown as differing by no more than two cents. in the two cases of "equal" and "just" tuning.

In the case of the imperfect consonance, C E, the dissonance is much greater—as much as 14 cents. But any one who watches with understanding the proceedings of a pianoforte tuner may notice how much more clear the judgment is, of perfect intervals, unisons, octaves, and fifths, considered as matters of fact, than of any others—even of the sweet major thirds. There are many things we enjoy at the moment of relaxing our faculty of strict definition—the very word "relaxation" illustrates this. Is not the enjoyment of musical thirds, sixths, and sevenths a case in point? Considering that the numbers expressing the ratio of a fifth, 2 : 3, are smaller than those expressing thirds, 4 : 5, and 5 : 6, it might be supposed that the fifth ought to be most grateful to sensation; but a soft duet is never composed on this principle, it rather abounds with thirds and sixths; though an improving solfeggio, which the pupils may not like so well, often contains the more bracing intervals, fourths and fifths, in prominent positions.

Besides the two scales in the diagram, distinguished as "just" and "equally tempered," the number of possible scales is quite bewildering, and Mr. Ellis, towards the conclusion of his paper on "The Musical Scales of Various Nations" ("Journal Soc. Arts," No. 1,688), remarks "that the musical scale is not one, not 'natural' . . . but very diverse, very artificial, and very capricious." One scale seems historically interesting in the progress of European music—that of mean tone intonation—which, "perfected by Salinas in 1577, prevailed over Europe for nearly 300 years. As long as only three sharps, F sh., C sh., and G sh., and two flats, B flt. and E fl., were required, it admirably answered its purpose of furnishing organs with endurable harmonies" (Ellis). When modulations extended to keys requiring other sharps and flats, such keys were called "wolf-keys," and were thought excruciating by those who principally regarded the physical sensation of music. Yet we do not find that S. Bach was deterred. by a dread of encountering "wolves," from completing his set of fugues in twenty-four keys. Preference for equal temperament, however, seems implied by the name "Das Wohltemperirte Clavier." Mr. Ellis, analysing a particular case, remarks that Bach "is thinking in tempered music" (Ellis's Helmholst, note to, p. 470); but neglects the general rule, that fugues are always so thought of, when really understood.* "Silberman, the great organ-builder of his time, maintained the mean tone temperament, and there are anecdotes of S. Bach's driving him to distraction by using it in an unsuitable key, as F minor" (Ellis). It would seem, then, that while the organ-builder was attending to sensation, the composer was intellectually absorbed with his composition, to the neglect of physical sense.

But Handel did not seem in like abstracted mood when he "gave to the Foundling Hospital an organ with stops arranged to play from four flats to five sharps (that is with sixteen mean tones to the octave). These stops having long become utterly useless, because not understood, were nailed up (!)" (Ellis). Then there was also the organ at the Temple Church previously to the extensive alterations half a century ago, with sixteen notes to an octave, obtained, I believe, by dividing some of the black keys, so that on touching an end in front one sound came, but on touching the back part another sound. There is a legend that the great composer Purcell was fond of playing on this organ at its first erection, some two centuries since.

It appears, however, that modern organists place too little value on these peculiar arrangements to desire to preserve them. I never heard of any duplicate of General Thompson's organ; and there would seem the faintest possible satire implied—I do not say whether intentionally—in this expression in Dr. Stainer's "Harmony:" "Many enharmonic instruments are now made in this country. An explanation of the reasons which prompt mechanists to construct them will be found," &c., &c.

Lastly, here is the opinion of a group of practical musicians, some of them of world-wide fame. "Suppress the tempered system, suppress enharmonic equivalence, the sameness of meaning for different signs, and by the same act you suppress the most beautiful inspirations of composers; you suppress music itself." From the French (in Translator's Notice to Helmholtz), signed, among others, by Auber, Berlioz, and Gounod.

Music seems a compromise between the claims of flesh and spirit. To what a degrading comparison it may be subjected when "fleshly lusts" are only regarded, may be seen by the following citation from Mr. Sedley Taylor's "Sound and Music." "The ear enjoys, in alternation with common chords, dissonances of so harsh a description as to be barely endurable when sustained by themselves. This constitutes a marked distinction between it and the other organs of sense. A stench is not improved by alternating with the most fragrant odours, nor nauseous foods rendered palatable when administered at intervals between the most delicious *plats*. A kick remains a kick, even though it be preceded and followed by caresses: . . . ." Mr. Taylor proceeds to illustrate his paradox by an instance, and draws it from a lofty source—the "St. Matthew Passion Music." A. O. D.

* See *ante*, letter 1883.

DOUBLE HEARING.

[1937]—I do not remember to have seen in Knowledge any allusion to the acoustic discrepancy which sometimes arises between the two ears under certain morbid conditions. I have noted this discrepancy on several occasions in my own case; and as I suppose I am physically constituted much as other people, I conclude that my own experience must tally with that of my fellow-creatures generally, though few, possibly, may have investigated the matter for themselves. I had often found that when suffering from illness—especially a kind of influenza bordering on low fever—musical sounds, however sweet their quality, became positively disagreeable to me. On investigating the cause, I ascertained that the one ear heard sharper or flatter than the other. A sound giving a certain number of vibrations to the right ear, gave a different number to the left. What was C, for instance, to the one, was C sharp, or perhaps B natural, to the other. A church-bell heard alternately by each ear gave two different notes, separated by at least one-third of a whole tone. The effect of listening with both ears was, of course, under such conditions discordant; and a passage played on the organ or piano sounded as though it were played in perfect time on two instruments not in unison. The greatest discrepancy I have ever noticed has been nearly half a tone. Last autumn, when ill and partially deaf in my right ear, I found that to that ear a musical note was flatter than to the left, the difference amounting to nearly a quarter tone. C. H.

A GRAVE QUESTION.

[1938]—What will be the value of history if each document which will be its basis is as *splendide mendax* as the following?:—

"'I began in '49 with a 'ackney coach, with a pair o' 'osses, and no box-seat but a kind o' perch fixed up over the wheel, off o' which you was pretty sure to tumble if you cut it the least fine round a corner. Kebs was just a-comin' in then, only they wasn't called kebs at that time.'

"'Cabriolets?' I suggested.

"'That's it; and a good time them 'ere kebriolays 'ad of it. In '51 there warn't no 'busses, you see, nor no hunderground railway, likewise no 'ansums'"——

Every single statement above is false. [Even about underground railways?—R. P.]

From 1845, in my native town in the North, the "railway omnibus" was a familiar object. Were we before London?

In Jan., 1847, when I went to school (in the same place), I found *cribs* called *cabs*, and a furtive glance at a shut book, up at class, was called *cabbing*, in allusion to the term *coach* for a private tutor.

In August, 1850, I remember arriving from Brighton at London Bridge near midnight (the engine having failed, and the company being too niggardly to telegraph for a fresh one). I had some difficulty in getting a *cab* (I should have expected to be taken for a "fogy" had I even seemed to *know* the word "cabriolet"). A driver said, "Will a coach do, sir?" I remember it was nothing like the machine described above, but a nice carriage and pair. At last I got a cab, and went to Putney in it.

Town at that time *swarmed* with 'busses, just as now. I do not remember when hansoms came in; but I went in one in August, 1853, from Smithfield to Charing Cross, my companion being the Head-master of Charterhouse School. This grave D.D. would never have risked his character in any new-fangled untried conveyance.

Cabman, cab-stand, were surely common words long before those days. An hour or two in the British Museum Library would soon decide.

The extracts above are from "Cabby," *Pall Mall Budget*, Sept. 10, p. 17, an article by an interviewer, apparently, and on the staff. *Si sic omnes!* Hallyards.

[I think there is a mistake of ten years in the *Pall Mall Budget*. For '49 it should be '39. Certainly I remember cabs in London before '49—and omnibuses as far back as 1845—how old they were then I know not. The word "cabriolet" had gone out of use long before '49 I think—that is for public conveyances. See *Punch*, the *Penny Magazine*, and Dickens's earlier novels, &c., for references to cabriolets, hackney coaches, omnibuses, &c., &c. R. P.]

A MAGNETIC UMBRELLA.

[1939]—It may be worth while to let you know that the magnetic umbrella alluded to by "Cosmopolitan" (1900) belonged to a friend of mine, who told me, by letter, of its effect upon the compass of the vessel in which he crossed over to England, and was greatly puzzled to account for the phenomenon. No earlier than yesterday, however, I wrote to remind him that, shortly before, he and I were on the Portrush and Bushmills Electric Tram, that I stood up to look at the cliffs and invited him to do the same, that on doing so he held his umbrella for a considerable time in an upright position directly (or nearly) over the conductor which conveys the electricity from the rail to the car, and that, consequently, that was how it got magnetised.

When Knowledge was only in its teens, I asked you whether the retrograde motion of the satellites of Uranus can be accounted for, and, if so, how? (Guess they growed so.—R. P.) W. A.

SAN GREAL.

[1940]—In letter 1931 "San Greal" (Holy diet) should be "San Greal" (Holy dish). "Grail" is derived from Low Latin *cratella* (not *cratelta*), diminution of *crater*, a bowl. The sentence preceding ("Icel. Dictionary") requires quotation marks.

There is no need of a far-fetched etymology for "Grail"; its derivation follows a rule to which there are no real exceptions in the French language. "The Latin medial *t* undergoes two successive changes: (1) it becomes *d* in old French; (2) this *d* disappears, as if it were an original Latin *d*; and then the two vowels which are thus brought together are contracted. . . . . Medial Latin *d* remained in French up to about the middle of the eleventh century. In the latter half of that century this *d* is softened into a sound half sibilant, answering to the two English *th* sounds. . . . . This rule has no true exceptions." (Introduction to Brachet's "Etymological French Dictionary.")

The following are a few examples:—

Grail (holy dish)	from cratella.	Noël	from natalis.
Grail (service-book)	from gradale.	Moelle	„ medulla.
Grille	„ craticula.	Vielle	„ vitella.
Cruel	„ crudelis.	Féal	„ fidelis.
Rouelle	„ rotella.	Fouiller	„ fodiculare.
Glaieul	„ gladiolus.	Poele	„ patella.

T. Common.

[I was unable to correct Mr. Common's former letter, proof of which unfortunately reached me too late.—R. P.]

TWO-SPEED GEARING.

[1941]—I regret that I was not able to reply immediately to "G. W. G.'s" inquiry respecting the Crypto Dynamic two-speed gear. I have had several opportunities of trying this gear, and think so highly of it that I am having a machine made especially to apply it to—one of the new front-steering tandems by Starley & Sutton.

I shall also very shortly have a Humber automatic front-steerer fitted with the same gearing.

On one point this gear is superior to any other two-speed gearing that I have tried—that is, the facility with which it can be changed from speed to power, or *vice-versâ*. This is a very strong point, as when there is any difficulty in changing a two-speed gear it causes so much time to be lost that the advantage gained is almost neutralised. John Browning.

LETTERS RECEIVED AND SHORT ANSWERS.

T. R. Campbell. Many thanks. — D. Letter received and contents noted. — James Hunter. Now my good sir; do be reasonable. No, you may *not* trouble us to hunt up the periodical in question, or to make the inquiries you require.—E. L. Girdlestone. Thanks for the lines you have copied for me. As for the balance—well, I hardly seem to care much for the specimen—either the idea or the wording. Light is silent, it seems, but calls up voices over sea and earth, and fills the air with harmonies. Well, the earth is silent, too, in its axial whirl, and that has as much to do with the voices and harmonies as the other: and Milton gave us poetry in that. Some of your poet's ideas are simply preposterous. We are told of a mighty murmur sinking to sleep on the down spread by darkness for wearied limbs and eyes! Murmur has been supplied (by this misery of a poem) with very strange bedfellows,—that is, if the wearied limbs and eyes occupied the bed spread for them: if the mighty murmur turned them out, or they got out, objecting to its company, that is another matter; but the poetry is not improved. What *is* a "creature ear?" or a "winged wail upon the wave." (Read aloud, these would suggest imperfect aspiration). "Earnest hum" I can understand; that describes the poem. Thank you all the same—I can bring my lecture on the Sun to a close without winged whales. Let them for the nonce keep within the "specifically evangelical circles" you mention. Hallyards. No room left now for more letters in weekly Knowledge, and monthly Knowledge will know none. Your impression about U. S. and G. B., and my views are erroneous. I am sorry you raked the other matter up. Such matters best left alone.—The S. D. C. (not the Soc. for Dif. Christ. Know.) was hardly worth noticing, being purely personal. You have got something wrong about it now, as in 1879 nothing could have been said about

it in *N. W. C.*; name not even heard of by me before 1881.—Your argument failed unless lines absolutely straight. Not my fault if you did not, or do not, see this—I inferred, *of course*, that you thought your French friend right. Thanks for suggested synopsis; but monthly Knowledge is to be different.—You think you have pointed out "gross errors"; those who wrote think otherwise. K. *had* such a series, but would have done infinitely better without it. The acting Editor objected to these papers strongly; but a misunderstood suggestion as to responsibility let them in, and nobody admits responsibility. Most certainly your addendum cannot be admitted. On the other subject Shakespeare said all that was necessary in the lines beginning "There's a divinity."—It is a pity you "have forgotten more astronomy than most men ever knew." I fear what you remember is mostly incorrect. The points numbered 1, 2, 3, 4 have not been noted by astronomers, and would have been, if real.—My style with "individuals" I explain as depending on the individuals.—It is well enough known that the extent of the condor's wings was formerly exaggerated. Humboldt dwells on this in his "Study of Nature." A saying by Buffon, however, hardly corresponds with a statement of an eye-witness. What an odd idea of yours that the rising of the tide condenses the air: fatal facility of explanation! But "pickled" by this remark of mine, you say, you were tickled to find the *Saturday Review* attributing to me the foible of omniscience. Have you yet to learn that the *Saturday Review* would say *anything*. My expression of opinion, even doubtingly, serves the *S. R.* well enough as a claim to universal knowledge. But people only read the *Saturday Review* to be amused, not to believe more than a very very little.—W. H. Jones.—Few letters can now appear in Knowledge, and yours is not suitable for an article. It is most certain, however, that the mind of the infant cannot be compared to a sheet of paper. Heredity is now an established scientific fact. This does not prevent what you advise in the way of training from being desirable. But your advice would appear better in a non-scientific paper.—"One who," &c.—Oh! but excuse me; you attributed to me a wish to see the R. Ast. Soc. crumble, as it were, into nothing before my imagined attacks. I *have* "written some rather sharp remarks" about squabbles in the R. Ast. Soc.; but that is not attacking the Society, rather the other way. I passed some of the pleasantest hours of my life at the meetings of the Society before the squabbles began; I know, too, that many like myself withdrew from the meetings because of them, and that the meetings are now, for that reason, very poorly attended. Some actually left the Society because so much of its time was occupied, and so unpleasantly, with the fight over the endowment question. The *best friends* of the Society did as I did,—deprecating squabbles, especially about personal matters, money, position, and so forth. You repeat that I got into a "mess" of some sort! I repeat that I know nothing of any mess. An anonymous writer, making use of knowledge which only Mr. L. should have possessed, led me into an erroneous belief as to the source whence his remarks came. By indicating my belief openly, I got that error corrected, at no expense to any one, except temporary annoyance perhaps to Mr. L., for which his own mistake in communicating what he should have kept to himself was responsible. If you imagine that it cost me anything to accept his explanation, you judge me wrongly—doubtless from internal evidence. You mistake in supposing that we admit anonymous letters into our columns. A letter which *appears* anonymously is not necessarily anonymous. All honest writers send their names to us,—"not necessarily for publication" as the form has it, "but as a guarantee of good faith": keeping back the name, in the case of a letter relating to personal matters, is a guarantee of bad faith: about the surest I know. Not knowing what was said about the Vegetarian Society, I do not know whether it was insulting, as you say, or not. If it abused vegetarians as such, I am sorry for it: because every man has a right to his opinions. But if it ridiculed the way in which some vegetarians treat those who do not agree with them, "I'm there." A letter, signed (name not necessarily for publication) stating what seemed objectionable, would have received attention.—Percy. Received.—Russell. Known and noted.—Gowrie. I think of publishing the Dif. Cal. papers soon: am away from my volumes of Knowledge and cannot recollect when those papers appeared. I have no idea how myself to pronounce some of the star-names. I used to say Aldebáran (pronouncing it Aldebáhran), and liked that even as the old lady liked that sweet word Mesopotamia (as a boy my favourite name was Monomotápa)—but now, having been sat upon, I say Al Débaran). Does it matter much?—Welshman. I prefer "dullness" to "dulness;" and "defense" is better than "defence." I also like "gotten," as "got" is an ugly sounding word. Americans never use the redundant "got" so commonly used by us, as "I have got" for "I have"—and I have gotten to dislike that redundant "got" very much.—R. M. Hutchinson. Thanks for "magic squares"; but we must not put them in the last few numbers of weekly Knowledge.—P. J. Beveridge. Where you go wrong, "as near as I can make it out," is here and thus:—"Darwin maintains that any circumstance which affects the balance of advantages in the struggle for life, will influence the process of evolution; you maintain that a circumstance too slight to affect the balance of advantages in the struggle for life will *not* influence the process of evolution: and you imagine you are maintaining something inconsistent with Darwin's views! So if a butcher showed you a scale for weighing meat, and told you that anything which brought down the balance on one side affected the price he would charge, and you were to take a hair (preferably a split one, I should infer from your letters) and to show that that did not affect the balance, you might triumphantly ask him how such a hair would affect his charges? This is all wrong: yet I would not "lock up all knives and dangerous weapons"; you are safe enough, I should imagine. Such errors of logic pour in on me by the basket (w.-p.)-full all the time.—*Quousque tandem.* It would be *abutere patientiam lectorum nostrorum* to print a letter about anything so musty as Columbus's egg.—Namron. Do not know it.—A. S. Cannot advise.—H. A. Bulley. Would prefer not to offer an opinion.

Miscellanea.

The largest profit by a German railroad in 1883 was 9·59 per cent. by the Right Bank of Oder Railroad. Four German roads earned more than 8 per cent., two more than 7 per cent., but no other earned as much as 6 per cent., while fourteen earned less than 3 per cent.

An American contemporary says: "The Pike's Peak Railway, which is expected to be in operation this year, will be the most notable piece of track in the world. It will mount 2,000 feet higher than the Lima and Oroya Railway, in Peru. It is now in operation to a point over 12,000 feet above the sea level. The entire thirty miles of its length will be a succession of complicated curves and grades, with no piece of straight track longer than 300 feet. The maximum grade will be 316 feet to the mile, and the average grade 270 feet. The line will abound in curves from 500 feet to 1,000 feet long, in which the radius changes every chain."

On the 3rd inst. the ground suddenly sank quite 10 ft. for eight yards on the towing-path of the River Weaver, close to the town of Northwich. The water rushed in, forming a lake. The Wheatsheaf Hotel, close to the place, has just been raised 3 ft. after subsiding. Soon after the collapse of the towing-path a more alarming subsidence occurred in the same neighbourhood. Underneath a coachbuilder's in Castle-street, a thoroughfare recently restored at much expense by the county authorities, a great quantity of earth suddenly disappeared, a considerable portion of the foundation wall and the adjacent roadway also falling into a chasm. The building stands on a huge wooden frame, one beam of which crosses the chasm, otherwise it must have been wrecked.

One of the bars at the entrance of New York Harbour, called Dimond Reef, is composed of indurated clay and boulders, which presented unusual difficulties in the way of dredging to the desired depth, and is now being removed by means of the attrition of powerful streams of water forced against the bottom by hydraulic dredgers. The mean velocity of the water discharged from the special mechanism used for the purpose is about 7,000 ft. per minute, and the *Nautical Gazette* reports that this "is sufficient to force the earth and clay at the bottom into suspension, to be carried out by the ebbing tide, which is the only time these hydraulic ploughs are used. After the clay is washed away, the boulders are removed by grappling-irons. This method has been so successful that it is being applied to that portion of the bar in Gedney Channel, which will secure a depth of 28 ft. at low water for a width of 480 ft. At the point selected for this work the bar is about 4,000 ft. in width, and the ebbing tide has a mean velocity of one and a-half miles per hour."

The British Association.—In the Mathematical and Physical Science Section, the "Relative merits of iron and copper wire for telegraph lines" formed the subject of a paper by Mr. W. H. Preece, of the General Post-office. He remarked that the Post-office had recently erected a copper wire between London and Newcastle, weighing 100 lb. per mile, with a view of testing its value against the ordinary iron wire, which weighed 400 lb. per mile. The cost of each was about the same. As regards speed of working, the copper showed decided superiority, the speed being—for simplex working, copper, 414; iron, 345; for duplex working, copper, 270; iron, 237 words per minute. Copper showed itself more susceptible to rapid reversal of electric currents than iron. Hence it was better for fast-speed working and for telephones. The progress made by the Post-office in improving the rate of working of the Wheatstone automatic apparatus was shown by the fact that while in 1877 the rate was 80 words per minute, in 1880 it was 170, in 1883 it was 250, and now it had reached 430 words per minute.

Our Whist Column.

By "Five of Clubs."

WHIST STRATEGY.*

A GAME at Whist is like a campaign in which at first you know little of the position of the enemy or of your ally, but as the contest proceeds you learn more and more, till towards the close you should know nearly all you want to know if you have watched the various indications of the game with proper care.

In different Whist games you play for different things. In some games (to take the broadest division of all), you play for victory, in others for safety. In some games your chief object is to bring in a long suit in others to prevent the enemy from so doing. Again, in some games it is essential to success that you and your partner should make your trumps separately, the suits being ill divided; while in others you see that this is the enemy's chief hope, and that you must play as carefully as you can to prevent it.

Take first the case where the hands, including trumps, are pretty equally divided. Observe, here, that in the play of each suit the momentary command of the suit is apt to alternate from hand to hand. If you can choose a moment when you have command of the plain suits (that is, you or your partner holding the best card in each), and can take out the last round of trumps at that time, either by having the power to get out three rounds, or because two rounds have been already taken out, then whether the last round in trumps goes to you or to the enemy, the next lead in a plain suit must go to you or your partner, and you can usually insure a fourth trick in one or other of the plain suits. This is the only kind of success that in such a case you have to play for. Seeing, then, how strong your position becomes when you thus hold the temporary command of the plain suits, you can see the folly of that mode of playing which is so commonly seen in Home Whist, where each winning card is played out at the first opportunity. Indeed it is only by bad play of that sort that the position I have imagined can arise; but it is quite common, when two bad players are partners, to see them make their Aces and Kings, then lead trumps because they cannot take another trick in a plain suit, and thus allow the enemy to make small cards which would otherwise have been useless.

The first of our four doubly-played illustrative games illustrates the advantage of correct play in such cases as these. By the old-fashioned plan of playing out all the good cards before leading trumps, *A B* with all the advantage of strength on their side, not only fail to make a good score, but lose the odd trick. Playing properly, without any special Whist strategy, they make five by tricks.

In all such cases, the point to be aimed at is to retain command as long as possible in plain suits, striving to wrest command from the enemy. Thus trump leading comes in early, but not *very* early. Each side strives to compass the extraction of trumps in such sort that the possession of command in plain suits may be most effective. We have here probably the origin of the rule, "When in doubt lead a trump,"—a most dangerous rule to follow as weak players follow it; but a sound rule as really to be understood. When a lead of any plain suit will transfer command in that suit to the enemy, and when therefore you are in doubt which plain suit would be the least mischievous to lead, it is generally well to lead trumps: for assuredly, if you can get out trumps at such a time, you and your partner will do well in the plain suits. Weak players follow the reverse rule. They are only in doubt which plain suit to lead at the time when to lead trumps would be destructive—viz., when whatever plain suit they lead the enemy will take a trick in it. *B* will say to *A*, "I knew *Y* would win in Spades with his Ace, and that *Z* had the best card in both the Diamonds and Clubs, so I led trumps,"—when what was really wanted was that those best cards should be drawn, and so the command transferred from *Y Z* to *A B*.

Next consider the case where one side has considerable trump strength and a long suit, the other side having protection in all the plain suits, and their few trumps about equally divided between them. This may be regarded as the typical example of attack and defence at Whist,—on the one hand we have the strategy for bringing in a long suit, and on the other the strategy for preventing such a result, if possible.

Here if trump strength in one hand of the attacking side is very great, the holder of such strength leads trumps at the earliest opportunity, or signals for trumps (though I must insist here yet once more on the necessity for very great caution in adopting this measure). If trumps can be extracted in such sort that either the last trick in trumps is taken or a long trump remains in hand, then when the long suit is led, there is a good chance that it may be established, and brought in by means of a re-entering card in one of the other suits, even though the long trump may have to be first employed in getting one of the leads required for establishing the suit. With less strength in trumps, it is better to get the suit established, or on its way to being established, before leading trumps. Remember always that protection in a plain suit of the enemy's means the probable power of re-entry through that suit: possession of the king-card (that is, the best card) in an enemy's suit means the certainty of re-entry through that suit if the enemy or your partner (at the right moment) should lead it. When trumps are out and your own or your partner's long suit established, this power of re-entry means usually the triumphant introduction of your long suit. Hence the importance, for successful attack, of the rule, "keep the command of the adversaries' suits."

How is an attack thus conducted to be met? It is generally impossible to lead trumps in order to avoid giving up the command in one or other of the plain suits. It is indeed usually essential to defence to make all good cards while you can, because the very object of the enemy in bringing in a long suit is to cause your good cards to fall without making tricks, before small cards of theirs. If then you have strong suits, and some protection in trumps, your plan is to play your strong suits, as if striving to bring them in: and to use them when established, or the best cards left in them even if they be not absolutely established, to force out trumps from the strong trump hand of the enemy. You may thus entirely defeat the adversaries' main object, reducing the contest to the case already considered, of fairly-balanced strength. If this is hopeless, be prepared for the necessity of making your strong cards while you can; lest the adversaries bring in a strong suit and some of your best cards fall before small ones. For you must remember that if the holder of a strong trump hand can bring in his own or his partner's established long suit, the small cards in this suit are as good as trumps.

In such a case hold on as long as you can to such protection as you may have in the adversaries' long suit, and retard as long as you can the extraction of trumps. When you get the chance make those winning cards you have which would else fall to the enemies' small cards.

The second doubly-played hand of our series illustrates the general considerations which have to be attended to in playing against a strong and long suit supported by strength in trumps. Playing correctly, *Y Z* resist the bringing in of the long suit, by retaining the King-card in the suit till the strong trump hand is exhausted in it. They thus only lose the odd trick, whereas they lose three tricks if they play otherwise.

(To be continued.)

* From the author's forthcoming work on "Home Whist."

In Austria, in 1883, the highest rate of profit on a railway was 16·12 per cent. by the Emperor Ferdinand Northern, and the next 9·40 per cent., while three others earned more than 8 per cent., two more than 7 per cent., and seven others more than 6 per cent. But twenty-six earned less than 3 per cent., twenty less than 2 per cent., and eight less than 1 per cent. In Poland the Warsaw and Vienna Railroad earned 13 per cent.

The Gordon Roadster Tricycle. This is a pilot-steering double-driver which has been introduced by the London Cycle Supply Association, Limited, and is as perfect a tricycle for general use as need be wished for. Without calling in the aid of fancy patents, which are often found to be meretricious when practically tested, the makers of the "Gordon" have endeavoured—and successfully—to produce a machine, not adapted to any particular class, or for any special purpose, but a good all-round tricycle suitable for those who go in for tricycling on recreative grounds. One of the most important improvements applied to the Gordon—and which, by the way, ought to be found in every tricycle of this type with any claim to safety—is in connection with the steering-rod. This is fitted in its proper place—below the frame, where it has more controlling power, and is far less dangerous, than when attached higher up. Attention has also been given towards minimising the vibration which is the great drawback with all front-steerers. In the Gordon this has been greatly modified by the insertion in the socket-head of a coil spring, upon which the weight of the rider rests; by this means a springy motion is substituted for the jarring and bumping so generally a source of complaint with riders. Between the top of the shoulders and the bottom of the socket there is a space to give the necessary play to the action of the anti-vibratory spring. The brake power has also been carefully studied, and can be kept at the desired strength by a quadrant ratchet, which by the aid of a spring-catch can be "set" according to the nature of the road. The Gordon tricycle is fitted with a comfortable saddle (supported by an "Arab" spring) which can be adjusted to suit the height of the rider; a first-class head-lamp; and a double-chiming alarum. Indeed, it is most completely appointed in every respect, and is offered at an "inclusive" price which should speedily secure for it a foremost place in the estimation of "knights of the road."

Our Chess Column.

BY MEPHISTO.

SCOTCH GAMBIT.

CONTINUING our investigation of the move of 7. Q to Q2 in the Scotch Gambit, we give the following interesting game, in which Black replied with 7. P to QR3. This game was played at the Hamburg Tournament, between Messrs. Blackburne and Mackenzie. We have hitherto failed to find good illustrative games of what, in our opinion, constitutes the best defence to this attack. We have, therefore, made a special engagement with a strong player to play some games to test our theory. We shall publish the games resulting from this experiment in due course.

ILLUSTRATIVE GAME No. 12.

	White. Blackburne.	Black. Mackenzie.
1.	P to K4	P to K4
2.	Kt to KB3	Kt to QB3
3.	P to Q4	P × P
4.	Kt × P	B to B4
5.	B to K3	Q to B3
6.	P to QB3	KKt to K2
7.	Q to Q2	P to QR3 (*a*)
8.	B to K2	Q to Kt3 (*b*)
9.	Castles (*c*)	B × Kt (*d*)
10.	P × B	Q × P
11.	Kt to B3	Q to Kt3
12.	B to Q3	P to B4 (*e*)
13.	KR to K sq.	P to R3 (*f*)
14.	K to R sq.	P to Q4 (*g*)
15.	B to KB4	Castles
16.	B × QBP	B to Q2
17.	B to B2	QR to Bsq. (*h*)
18.	B to Kt6	KR to K sq.
19.	B to Kt3	B to K3
20.	R to K2	K to R sq.
21.	QR to K sq.	B to B2
22.	Kt to R4	Q to B3
23.	B to B5	P to B5
24.	Kt to Kt6 (*i*)	QR to Q sq.
25.	P to B3	P to Kt4 (*j*)
26.	B to B2	P to KR4
27.	P to QKt4	K to Kt2
28.	P to QR4 (*k*)	Kt to B4
29.	R × R	B × R
30.	B × Kt	Q × B
31.	P to Kt5	P × P
32.	P × P	Kt to R2
33.	B to K7	R to Q2 (*l*)
34.	Kt × R, and White won.	

BLACK.

WHITE.

Position after Black's 14th move.

NOTES.

(*a*) We consider that this move leads to a defence equal to 7. B × Kt. Black must, however, bear in mind that his KB is unsupported, and cannot retire to Kt3 or R2 with advantage. Black is, therefore, threatened with Kt × Kt, and he must beware lest this should cause him inconvenience. Thus, for instance, Black could not Castle immediately, on account of White playing Kt × Kt, B × B. Kt × Kt (ch), Q × Kt. Q × B, and White has won a piece. This is the usual feature in this Opening. The object of 7. Q to Q2 is to keep up this position, as it is apparent that White thereby supports his B, is enabled to play Kt to Kt5 or B to KKt5, prevents Black's Castling, and if Black plays 7. P to QR3, an inactive developing move, White gains further time for an active developing move, *i.e.*, a move in which a piece is developed.

(*b*) Removes the Q from a square when it can be attacked by B to Kt5.

(*c*) White gives up a P for the sake of development, hoping to bring his pieces strongly to bear upon Black's game, before the latter has time to arrange his game safely.

(*d*) Black dare not play 9. Q × P at once, as White would at once get a winning attack by 10. B to B3, Q to Kt3 (if Q to K4, 11. B to B4). 11. Kt × Kt, B × B. 12. Kt × Kt, B × Q. 13. Kt × Q, and White has won a piece. Black is almost compelled to play B × Kt, for White now equally threatens what we have indicated in note *a*, namely, 10. Kt × Kt. If Black plays 9. P to Q4. 10. Kt × Kt, Q × Kt. 11. P × P, Kt × P. 12. B to B3 with a good game. If, therefore, 7. P to QR3 does not sufficiently protect Black, so that after all he is compelled to play B × Kt, then, of course, B × Kt at once, without P to QR3, must be better; the difference, however, being that now Black gains a P. Yet another move deserves consideration—*i.e.*, 9. B × Kt, 10. P × B, P to Q4. This we think safer than Q × P.

(*e*) If Black played 13. Q to R4, his Q would be uncomfortably placed. White might reply with 14. Kt to K4, or R to K sq., or B to KKt5. He might also risk the following, if he be rash and enterprising:—13. Q to R4. 14. P to Q5, Kt × P. 15. Kt × Kt, Q × Kt. 16. KR to K sq., and Black dare not Castle.

(*f*) Castling would be bad, on account of 14. B to KKt5.

(*g*) P to Q3 would have been better (see diagram).

(*h*) R to K sq. at once seems the move, the B cannot do any harm on B7.

(*i*) White's play from his 18th to the 24th move is very fine, and shows how, taking advantage of his superior development, he presses on Black's isolated P, and gradually places all his pieces in strong positions.

(*j*) A despairing move, as the strong position of White's pieces (the true way of getting an advantage) leaves Black no resource.

(*k*) White thinks he has nothing to fear from Black's attack on the K's side.

(*l*) Black could not avoid the loss of the exchange, *i.e.*, R to Kt sq. 34. B to Q6, R to Q sq. 35. B to B7.

THE *Scientific American* contains an account of an accident which recently happened at Camilla, N.Y. Five horses were standing with their necks over a wire fence, when a flash of lightning struck the fence at a distance of 1,000 feet from the animals. The current traversed the wire, and went to earth through the horses, killing them instantly.

ACCORDING to American advices, says the *Engineer*, the Panama Canal Company is in difficulties. Some time ago a New York engineer was sent to Panama to examine into the affairs of the Canal Company in the interests of a New York syndicate, who proposed to contract for building the canal. It is sufficient to say that his advice was to wait for the crisis which was near at hand. Up to September, 1884, M. de Lesseps and his company had raised 111,000,000 dols. and expended 104,000,000 dols., their liabilities being 153,000,000 dols., their securities being sold at a discount. May 1st, 1885, less than 10 per cent. of their excavation, or 12,376,500 cubic mètres, had been completed, the total being estimated at from 125 to 150 million mètres, and there is the dam for the Chagres river, for which no foundation has been found after boring to the depth of 60 feet. The entire cost of the canal is estimated at not less than 530,000,000 dols., representing liabilities amounting to 600,000,000 dols. The *Financial News* estimates that upon this scale of liability there will be an annual deficit of ten millions of dollars.

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THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

HEAD-GEAR AND OLD FASHIONS.

On the philosophy of head-gear but little need be said. "Man's bare back" is so exceptional, that it has been regarded as a puzzle by some biologists; but when we note that the position of the top of a man's head is, relatively to absorption and radiation, the same as that of a quadruped's back, the anomaly vanishes. In both cases that part which has the greatest need for such protection is the best protected naturally.

First as regards radiation. Bodies radiate equally in all directions, nevertheless, if a warm body shaped like the trunk of an animal were placed on the ground on a clear, cold night, it would not cool down equally on all sides. If placed upright the head would soon be the coolest. If lying on its side, the upper side corresponding to the back of the animal would cool more rapidly than any other part. The reason of this is that *all* bodies radiate, including, of course, the earth itself. Those parts of the body exposed to the terrestrial radiation would be receiving as well as losing heat, obliquely, it is true, as regards the upright sides, while the part presented to the clear sky would radiate into space, receiving very little indeed in return; therefore, the natural heat-retaining apparatus is most demanded on that part of the animal which is subject to perpendicular exposure—*i.e.*, the top of the head of man and back of quadrupeds.

But the hair does more than this. It serves as a protection against the excessive heat of the direct solar rays. These, coming from above, again demand the greater supply of hair on the part which is perpendicularly exposed. This demand is further increased by the fact that the brain and the spine are the most delicate organs of the body, and the most liable to serious injury from excess of heat. In the recent Soudan expedition, where our men were making roads and doing other work that exposed the back to the direct radiation of a tropical sun, they were provided with special spine-protectors. Many thousands of long pads to be worn along the spine, and thus imitate the extra back hair of hyenas, hogs, &c., were made at the Pimlico works, and were found to be highly beneficial.

The question of whether our natural head covering is sufficient or should be supplemented artificially is a fair one, but is not easily answered. Our bald-headed brethren can answer for themselves at once without any hesitation; but, as there are so many gradations between baldness and luxuriance, it is evident that no general answer can be given. I can only express an opinion in which I believe the majority of those who have studied the subject will concur—viz., that whatever fashion of head covering is used, it should be as light and as porous as possible, and that even this should never be worn unnecessarily.

I have observed that those who habitually wear warm head-coverings indoors become prematurely bald. My attention was first directed to this subject when working in a laboratory as a student of analytical chemistry. It was then, both in this country and Germany, a common habit or practice for professors, their assistants and pupils, to wear smoking-caps, or Kepis, or German burschen caps, all of cloth, and many lined rather thickly, some even padded with wool. I encountered a larger percentage of prematurely bald heads among the professors and their assistants than any other class. Subsequently, whenever I have my hair cut, I ascertain the opinion of the artist on this subject, and have found a near approach to unanimity among the most intelligent of hairdressers concerning the injurious effect of keeping the head too warm. They are perfectly unanimous as to the "strengthening" effect of keeping the hair cut short, and, after all due allowance for professional interests, I have no doubt that they are right.

The coolness thus obtained is doubtless an element in this strengthening of the hair, and there may be in addition an action analogous to that which induces increased growth of the cuticle when it is abraded.

It is said that the veteran chemist Chevreul, who has now entered his hundredth year, never wears a hat of any kind, indoors or out of doors, unless conventionally compelled to do so. In the August number of the *Popular Science Monthly* is a portrait of this very grand old man. One of its most striking—I may almost say startling—features is the luxuriance of hair.

One conclusion may be stated very positively—viz., that no artificial head clothing is equal to that supplied by nature, and therefore, if the artificial does damage to the natural, away with the artificial; throw up and away your hats, and cry "Vive Chevreul et chevelure!" I have acted on this principle for many years, never wear a hat in my own garden, or anywhere else where I am free, as a protection against cold or rain; only against the scorching rays of the summer sun, then a light straw hat with the lining ripped out; and have never taken cold in consequence.

The possibility of dispensing with head covering even in the midst of all our artificial surroundings, and in spite of inherited habit, is well shown by the boys of that shamefully-abused charity foundation, the London "Blue-coat School," where the sons of well-to-do and even wealthy people (some of whom denounce as pauperising Chamberlain's proposal to give free education to the poor) are freely educated, clothed, and fed. These boys have their hair close-cropped, and are only allowed very scanty caps that practically are of no use. They usually go bare-headed and nearly bare of hair. If this were injurious it would be shown in so large a number by the prevalence of some form of consequent disease among them. I have heard something about sunstroke, but

nothing serious. Those in Newgate-street have the protection of London smoke, but not so at Guildford.

The fashion of clothing is a subject beyond my reach. If I attempted to treat it in detail, Mr. Proctor would possibly ask where the "philosophy" comes in, and I should find some difficulty in replying.

There are, however, a few general principles bearing on this part of the subject that may be briefly stated. One of these is that clothing should never have the character of bandages, should never interfere with the free and natural movement of the body. When I was a young man no male person was admissible in "good society" without a "cravat" or "stock." I painfully remember my own struggles against this despicable, conventional tyranny, and the abominations with buckles behind, which, in spite of my revolutionary predispositions, I was sometimes compelled to wear. When I cast them off, liberated my imprisoned neck, and wore a small tie and turned down the ear-cutting and stiff-starched upright collar, I was sneered at as a conceited puppy, mimicking Lord Byron. Now I can dispense with any necktie whatever, have done so for more than twenty years past, and am no longer insulted. I name this as one of the evidences of rational progress and the dethronement of the fashion-fiend as regards our sex. Thirty years ago we were all obliged to strap down our trousers under our boots, and to wear those abominations called "Wellingtons." Then it was absolutely necessary for a young man to mutilate his face daily with a surgical instrument called a razor. If he did not his moral character was assailed, and all the ordinary avenues for earning a respectable livelihood were closed against him. A City clerk would have been subject to instant dismissal if he wore a moustache; a curate with a beard would have been admonished by the bishop, and rising in the Church was impossible to such a disreputable person. A bearded barrister could not have obtained a brief. Only one British constituency dared to elect a bearded representative, and that was Birmingham. Muntz's beard was a foreboding symbol of the subsequent political career of that terrible town.

Would that I could speak in like terms of the emancipation of woman! Her stays to-day, with the scaffolding of steel and whalebone, are like our stocks of that period, but they are far more mischievous. But I must postpone this subject and that of the moral philosophy of female fashions until my next and concluding paper.

THE BIRTH OF WORLDS.*

THE new star in Andromeda has been popularly regarded as probably a new world. This, whatever else it may be, it assuredly is not. In like manner the new star in the Northern Crown was popularly regarded (by persons unversed in science) as a world in flames. Stars are of course not worlds, whether they be new or temporary or simply variable. The idea gains ground steadily that all so-called new stars—even the glorious orbs seen in remote times, which outshone Sirius in splendour—were but variable stars, with a somewhat exceptional range of variation, and probably of very long period. If the star Mira or Wonderful, in the constellation Cetus, were so situated that when at its faintest it was visible as a third-magnitude star, it would outshine all the stars in the heavens when at its *maximum* of splendour. So would Eta Argûs, and so also would the so-called new star in the Northern Crown. Indeed, if we regard the nebula in Andromeda as lying further away than the faintest star visible to the naked eye, then, were we brought so much nearer that its distance was only that of a first-magnitude star, the *nova stella* (probably but a *stella mutabilis*) which shone out recently in its midst would have been resplendently visible instead of needing a telescope for its detection.

Neither this star, nor any other new variable, or temporary star ever observed, can be said to have thrown the least light on the birth of worlds. Certainly, if the nebular hypothesis of Laplace represents the real way in which solar systems are formed, no new star has thrown light upon that process, or possibly can; for the process imagined by Laplace involved no catastrophes. It was a steadily acting process, rather leaving nebulous rings behind than throwing them off as commonly supposed; the rings separated into parts as they shrank longitudinally by a gentle movement, and the various fragments coalesced rather than collided, for they were all travelling the same way round; in fine, Laplace imagined no fierce conflict of matter with matter such as the sudden outburst of splendour in what we call a new star necessarily implies.

It might be well, however, if the interest excited by the new star, though it may throw no new light on Laplace's hypothesis should direct some degree of attention to the very remarkable defects which any astronomer who knows ought of physics, or any physicist who knows much of astronomy, cannot fail to recognise in that remarkable speculation. Attracted by the effective way in which some features of our solar system, for which the theory of gravitation cannot account appear to be explained by Laplace's hypothesis, many astronomers overlook the startling difficulty which Laplace overleapt at the outset. On the other hand, many physicists are unaware that the hypothesis started from what, with the knowledge of physics obtained since Laplace's time, is seen at once to be an absolute impossibility; they know only that a number of astronomical facts appear to require some such theory; of the details which are also required (but which a physicist at once sees to be quite impossible) they know little.

Let us consider how the theory of Laplace was suggested and what the theory required, premising that if the basis of the theory shall appear to be more than unstable that involves no discredit to Laplace, seeing that in his days certain physical laws which are now among the axioms of science were not even suspected. We may take, as an example of what Laplace could and could not do, that masterpiece of mathematical analysis, his inquiry into the stability of Saturn's ring-system; here the mathematical work was almost perfect, and the conclusion, that the rings must be narrow and eccentrically weighted, was demonstrably right, on the assumed premisses; but these premisses were erroneous. A knowledge of physical laws such as Laplace could not have, but such as many boys in our time have acquired, would have shown Laplace that the rings of Saturn could not be what he assumed them (quite unquestioningly) to be at the very outset of his inquiry. Solid rings on the scale of the Saturnian system could no more remain unbroken under the forces to which they are subjected than a model of the Menai-bridge, perfect in all other respects, but on such a scale as to span 100 miles, could bear its own weight. In this case, where not a theory, but a magnificent calculation of his, was in question, science has not hesitated to set Laplace's conclusions aside, because of the falsity of his assumptions, adopting, instead, the results

* From the *Times*.

which Clerk Maxwell, Pierce, the Bonds and others have established—viz., that the Saturnian rings consist of myriads of tiny satellites, like sands on the sea-shore for multitude. But, strangely enough, in the case of his far-famed (chiefly because so imposing) hypothesis of the birth of worlds, which starts from a similar, or rather from a much more monstrous, mistake (very natural, though, in Laplace's time), science has scarcely even questioned his results, far less examined his initial assumptions.

The facts which the nebular hypothesis of Laplace was intended to explain are simply these :—The planets travel the same way round, and in nearly the same plane (all but the zone of minor planets, whose entire mass is less than the tenth part of our earth's). The central sun turns the same way on his axis, so do all the planets whose rotation has been observed; all the moons travel round their ruling planets the same way—except the moons of Uranus (known, it must be remembered, to Laplace) and the moon of Neptune; and these bodies, travelling as they do at the very outskirts of our system, may be regarded as having, perhaps, been exposed to disturbing influences affecting, in their case, the action of the laws, whatever they were, which gave these features of uniformity to our solar system. Laplace suggested, as a hypothesis which seemed to him to result (*une hypothèse qui me paraît résulter*) from these features, that the whole mass of matter out of which the solar system was formed was once an immense disc, extending beyond the path of the remotest planet now known, and rotating as one gigantic whole. Granting only this assumption, and starting from it, all the features of the solar system mentioned above would follow. The ring would gradually shrink as its heat was radiated into space, until the outer parts, retaining their original velocity, could no longer cohere, but would be left outside in the form of a gigantic ring. This ring, as it further shrank (along its length now), would dissolve into fragments, and these would eventually coalesce into a single planet, the outermost. Then another would be formed in the same way, and another, and yet another, until at last there would be left, in the middle, the great mass which was afterwards to govern that family of worlds. Each planet, at its beginning, being like the original gaseous disc, would go through a similar process of contraction, and form as many bodies subsidiary to itself as its quantity of matter and the conditions under which it had itself been formed would allow. The process would fail in some cases, and so several small planets would be formed instead of one large one, as we see in the case of the asteroids; or, as in the case of Saturn's system, a ring or set of rings (rings of small satellites, as we now know) would form instead of a single large satellite.

Laplace's theory, if we grant its initial assumption, accounts fairly for all the features of the solar system, except the singular distribution of the planets into families—the giant planets outside, as if guarding the rest; the terrestrial planets near the sun, as if under his protecting wing; the asteroids or minor planets in the mid space between these families, as if keeping them apart. But, unfortunately, the initial assumption, on which the whole theory depends, is as utterly inadmissible as the theory that Saturn's rings might conceivably be solid. It is almost inconceivable how amazingly impossible that initial assumption is. Few probably know that a solid disc of steel, extending only to the earth's orbit, could not move as a single mass. If the central part of such a disc—say a region as large as the sun's globe—were set rotating as by some mighty hand, the outer parts would not feel the impulse until more than ten months had elapsed. But imagine a disc extending to the orbit of the planet Neptune, thirty times further from the centre than is the earth's path. Imagine, further, such a disc-shaped region of space, not occupied by a mighty mass of the stoutest steel, but by a vaporous mass many thousands of times more tenuous than the air we breathe. It is such a disc that we have to imagine, according to Laplace's theory, rotating as a single mass. No argument is really needed to show that this is absolutely impossible. But it is a truly remarkable circumstance that, while a mathematician like Clerk Maxwell did not hesitate to point out (with perfect justice, be it remarked) that the solid flat rings which Laplace recognised in the Saturnian system, because they seemed to be plainly visible there, would be absolutely plastic under the forces to which they were exposed, astronomers and physicists have been apparently afraid to acknowledge that a vaporous disc such as he only imagined, a disc rarer than the rarest known gas, so vast that the whole Saturnian system would be but as a speck by comparison, and moved by far mightier forces than act on that system, could have no coherence whatever, and could not possibly even begin to behave as Laplace's theory required. If the mere mathematician had been thus weak, we might not have wondered, for mathematicians often rejoice over problems depending on impossible conditions — perfect rigidity, absolute uniformity, entire absence of friction, and so forth. But physicists and astronomers have usually required conditions more in accordance with the actual workings of nature.

A MAN WHO HAS BEEN SHOT THROUGH THE BRAIN.

By William F. Fluhrer, M.D.*

On the 24th of January, 1884, I was informed by my house surgeon that Bruno Knorr, a healthy young man, nineteen years old, had, on the morning of that day, been admitted into one of my wards at Bellevue Hospital, suffering from a pistol-shot wound penetrating the brain through the centre of the forehead. On my visit at 3 p.m. I found the patient semi-unconscious. When aroused he was irritable, and in answer to all questions grunted "ja." There was complete loss of motion without loss of sensation on the right side of the body below the head. The left side of the body was hyperæsthetic. This increased sensitiveness was very marked upon the left side of the scalp near the ear. The pupils were of equal size and rather widely dilated. His pulse was 100, temperature 101·4. There was no history of the circumstances of the occurrence of the injury. It has, however, since been learned from the patient that, at about half-past four o'clock on the morning of the day of admission to the hospital, while lying on his back he shot himself with a pistol held in contact with the forehead. Instantaneously he became unconscious, and remained so for about three-quarters of an hour, after which he awoke, and with much difficulty, on account of weakness from loss of

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blood, arose and left the house. He walked about an eighth of a mile, and then got upon a horse-car while in motion and took a seat inside. When called upon by the conductor to explain the nature of his injury, he could not speak, although he knew what he wanted to say. After riding about three-quarters of a mile he was put off the car by the conductor. He distinctly remembered having swung himself from the car with the aid of his right hand. After walking about an eighth of a mile farther, he stood upon the corner of the street till a policeman came and conducted him about one-third of a mile to the station-house. There he was questioned by the officer in command, but was unable to speak. Not long after he became unconscious. He was admitted into the hospital at about 8 a.m., when his wound, from which brain-matter was oozing, was dressed antiseptically.

Preparatory to the operation, the patient's scalp was shaved. He was then etherized. A flap of gutta-percha tissue was fastened to his forehead to protect his eyes from the antiseptic solution of bichloride of mercury, 1 part to 1,000 of water, with which the parts were to be irrigated during the operation. The bullet-hole, of small size, was very nearly in the centre of the forehead. The skin at the right margin of the opening was more ragged than at the left side. The epidermis was blistered off for a little distance from the opening. There were no powder grains in the skin. The soft parts were puffy.

To ascertain the direction of the wound through the soft parts and bone beneath, a silver probe with a large knob was passed into the wound perpendicularly to the surface of the skull. To pass the probe through the opening in the bone I found it necessary to direct its course outward at an angle slightly divergent from the median plane of the head. In passing the probe thus far, the right margin of the opening in the skull was felt to have a depressed shelving-edge. An incision an inch and three-quarters long was then made from below upward to the centre of the bullet-hole. This incision was parallel to the median line, and just to the left of it.

[Here follows an account, occupying three long columns, of the operation for tracing the path of the bullet (which had passed to the back of the skull, and had thence been deflected towards the left), and extracting the bullet when found. The account is full of matter interesting only to surgeons.]

The operation was completed in about four hours from its commencement, the greater portion of the time having been spent in stopping the cerebral hæmorrhage. The following-named members of the house staff were present at the operation: Dr. R. T. Morris, Dr. J. R. Conway, junr., Dr. W. W. French, Dr. J. H. Woodward, Dr. H. N. Williams, Dr. P. Oppenheimer, Dr. H. S. Wildman, Dr. H. Herman, Dr. H Biggs, Dr. E. Hurd, Dr. C. F. Roberts, and Dr. W. G. Rutherford.

The patient's general condition after the operation was about the same as when it was undertaken. He was transferred to the Sturgis Pavilion, special orders being given that he should not be allowed to suffer from retention of urine, and that pain should be relieved by sufficient doses of morphine.

At nine o'clock p.m. the patient's temperature was 101° Fahr., his pulse 120, and respiration 32. A hypodermic of Magendie's solution of morphine, seven minims, was given; his urine was drawn by gum-elastic catheter.

January 25.—The patient is in about the same condition as before the operation. He is semi-comatose, still hyperæsthetic upon the left side of the body, and irritable when aroused. He drinks milk with an apparent relish, and puts out his tongue when told to do so.

[From this time onward there was a gradual improvement and final recovery.]

In treating the herniæ cerebri it was my aim to deal gently with them, at the same time keeping the wounds aseptic. In the period of their formation no pressure was made upon the brain protrusions. I looked upon their production as in part due to swelling of the cerebral tissue as a result of its injury, and based my non-interference upon the intolerance to pressure of acutely swollen or inflamed wounded tissues. From this point of view, the openings, of considerable size, in the skull were a benefit in the treatment of the deep brain injury in its early stage rather than a disadvantage. In a later stage, however, when the brain protrusions had reached their greatest size and the course of the wounds had become chronic, I thought it advisable to aid the recession of the herniæ by gentle and evenly applied pressure.

On May 22, 1884, I exhibited Knorr at Bellevue Hospital to a number of physicians. He was then, so far as could be judged, in perfect health. Apart from the scars upon the patient, the only abnormality discoverable was a limitation of the visual field for green and red observed by Dr. W. F. Mittendorf. Inasmuch as this feature was common to both eyes, it is questionable whether it was caused by the injury.

The bullet entered at the centre of the forehead, an inch and a quarter above the upper level of the eyebrows; it passed in a straight line through the brain, and was then deflected to its place of lodgment—an inch and a half to the left of the posterior medain line. The probe having been passed through, the straight portion of the wound was eliminated in the further search for the bullet. The probe was then passed through the deflected course after the same method as employed for the exploration of a tortuous wound. The bullet could have been followed about three inches farther upon its deflected course till arrested by the tentorium, the end of the probe being exposed by a second counter-opening in the skull.

The bullet cut upon the superior longitudinal sinus and penetrated the brain in the first frontal convolution, just at the edge of the hemisphere, where the convex surface joins the inner surface; traversing the brain-substance of the hemisphere, it emerged and lodged in the superior parietal convolution. The distance between the two openings in the brain, in a straight line, was six inches and a quarter.

In order to locate the injured cerebral artery with reference to the course of the ball, I carefully marked upon a cadaver the points of entrance and emergence of the bullet. I then removed a section of the skull to enable me to pass a straight-edged, long knife through the brain, in a straight line between these points. Upon removal of the brain, it was found that the cut in the first frontal convolution was down to a large branch of the anterior cerebral artery, lying about half an inch from the surface of the brain.

The patient left the hospital, where he had for a long time been retained simply for observation, on June 30, 1884.

About August 1 the patient went back to work at his old employment in a butcher's shop. He remained at work during the exceptionally hot weather in the early part of September.

On September 12, between twelve and one o'clock in the morning, Knorr received a heavy blow in the anterior

scar from the elbow of the man with whom he was sleeping. Knorr states that he suffered intense pain in the head for half-an-hour, when it died away, and he fell asleep again. He awoke at about four o'clock and noticed, with wonder, his right forearm beginning to flex upon the arm. He tried to hold it down with his left hand, but failed. Then his right leg was drawn up. Then his left upper and lower extremities, respectively, became affected in the same manner. He remembered being asked what was the matter, and that he could not speak, but screamed, and then lost consciousness. The convulsive movements were so energetic that the patient was thrown from his bed upon the floor.

The same day he went to work, but did not feel well. The physician who attended him during my absence from the city prescribed twenty grains of bromide of potassium with fifteen grains of bromide of sodium, in a wineglass of water, every four hours. The medicine acting as a cathartic, Knorr took it rather irregularly, and for ten days prior to Oct. 1 had abstained from its use altogether.

On Oct. 1, while delivering a parcel at the house of a customer, he was seized with a slight rigidity, followed by a short convulsive movement of the limbs and a momentary loss of consciousness, but did not fall. He walked away, and continued to work all that day, but he "felt sick all over." He consulted me upon my arrival home that day. I immediately impressed on him the importance of persistently continuing to take his medicine. I prescribed fifteen grains of bromide of sodium with thirty grains of bromide of potassium, to be taken, largely diluted, every morning and evening.

He soon came under the influence of the medicine, as shown by the eruption of acne and insensibility of the fauces.

He has continued to take the bromide in doses of twenty grains in the morning and thirty grains in the evening, and has had no recurrence of convulsions or other epileptic symptoms whatever for a period of nearly six months. When he began working after his discharge from the hospital he noticed, in trying to keep in mind the orders for deliveries to customers, that his memory was not so good as before the injury. He now follows the same occupation, and performs the same duties in it, as before he was shot. He feels perfectly well, and, by the test mentioned above, is sure that his memory is constantly growing more retentive.

The openings in the skull are closed simply by the soft parts. The posterior scar is depressed about three-eighths of an inch, and pulsates to the touch. The anterior scar, which for a long time was very thin in two spots, is constantly growing firmer. It is depressed one-quarter of an inch, and visibly pulsates. Each scar bulges about one-quarter of an inch above the surrounding surface when that portion of the head is made dependent.

The advisability of extracting from the brain a deeply-lodged projectile follows, necessarily, from the case of Knorr.—*New York Medical Journal.*

Burnham Beeches.—Mr. Francis George Heath has presented to the Queen a copy of the holiday edition of his "Burnham Beeches," which she has been pleased courteously to accept.

Royal Victoria Hall and Coffee Tavern, Waterloo-bridge-road.—Mr. Clement Hoey has kindly undertaken the arrangement of a series of ballad concerts for the above hall on Thursdays during the winter. He has secured the assistance of many popular artists, and will give the first concert on Oct. 8. Science lectures will be given each Tuesday in the month: on Oct. 6, by Dr. A. H. Fison, on "Some other Worlds"; that on the 13th by Prof. H. G. Seely, on "Coal."

MYSTERIES AND MORALITIES.

By Edward Clodd.

IX.

The earliest known version of the *Harrowing of Hell*, the subject of one of the oldest English Mysteries, is preserved among the Harleian MSS. in the British Museum, and was privately printed by Mr. Payne Collier, together with four other sacred plays, in an edition of twenty-five copies—a number which, however, was "found more than equal to the demand, from any interest taken in this important and curious subject."

The Prologue invites all to hearken how Dominus or

> Jesus wes to helle ygan
> Forte vacche (fetch) thenne hys
> Ant bringen hem to Parays.

When Dominus appears, Satan parleys with him on the unfairness of being deprived of what was fairly won, and argues that

> Whoso buyth any thyng
> Hit is hys ant hys offspryng.
> Adam hungry com me to,
> Mourade (homage) dude y hym me do.
> For on appel ich gif hym,
> He is myn ant al hys kinn.

Dominus replies that the apple with which Satan bought Adam's soul was not his to give:

> The appel ant the appel tre
> Bothe were maked thourh me.

Arriving at "helle-gates" Jesus commands that they be opened, and at his voice the porter or "gateward" runs away in fear. Then the gates open, and Satan, apparently unresisting, is bound till "domesday." Adam, Eua (Eve), Habraham, Dauid, Johannes, Moyses, all welcome their delivering Saviour in turn, and the play ends with a prayer for grace

> to libbe ant end,
> In thi service ant to hevene wende.

The Coventry play comprises only six verses, but the York and Towneley, which are so closely parallel as to indicate derivation from a common original—perhaps the Mystery referred to above—run to much greater length, introducing numerous characters. In the first scene, which is laid outside Hell-gate, Jesus declares his intention to unbind the imprisoned souls whom he had ransomed with his blood, and sends a light into the murky darkness that they might know of his coming. Adam and the others make a joyful noise thereat, alarming the demons:

> *I. Diab.* Helpe! Belsebub! to bynde ther boyes,
> Such harrowe was never are herde in helle.
> *II. Diab.* Why rooris thou soo, rebalde? thou royis
> What is be-tidde, canne thou ought telle?

and so forth, till Belsebub calls "Satan oure sire" and the other devils to council. The voice of Jesus is heard without—

> *Attolite portas principes,*
> Oppen vppe ye princes of Paynes sere;
> *Et elevamini eternales*
> Your yendlas gatis that ye haue here;

the trembling fiends discuss who it may be, when at the like summons, *Attolite*, &c., the gates yawn, and Satan, ascending from hell-pit, parleys with Jesus, as in the older version, on the gross injustice of releasing the already damned, and is at last allowed to retain the souls of

murderers, unbelievers, and the like. He chuckles at this, knowing full well how soon he will fill hell again.

For I schall turne thame tyte I trow,
I schall walke este and weste
And garre (make) thame werke wele werre (worse)*

But Jesus calls "Mighill (Michael) myne aungell" to chain the devil in his "selle," and despite Satan's prayer to Mahomet for help he "synkes to helle pitte." Jesus then bids Michael lead Adam and the rest to Paradise, while he returns to the grave "redy to rise vppe-right."

In the Chester play, Satan announces to his "hell-hounds" the intended visit of Jesus, but the distinguishing feature of this pageant is in the conclusion, which was probably added as a satire against vices of the day, notably in this case against the cheating practised by tavern-keepers. A woman who had been in that business addresses Sir Sathanas, sergeant of hell, after Jesus had harrowed it, and tells him how she had defrauded her customers with bad wines and short measure, adding that she will stay and keep him company.†

Mulier.

Wo be to the tyme when I came heare.
Wofull am I with thee to dwell,
Sir Sathanas, sergante of hell;
Endless paines and sorows cruell
I suffer in this place.
Some tyme I was a taverner,
A gentil gossippe and a tapstere;
Of wyne and ale a trustie brewer,
Which wo hath me wroughte;
Of cannes I kept no treue measuer,
My cuppes I soulde at my pleasauer
Deceavinge manye a creature.
With hoppes I made my ale stronge,
Ashes and erbs I blend amonge,
And marred so good maulte;
Therefore I may my handes wringe,
Shake my cannes and cuppes ringe;
Sorrowful may I siche and sing
That ever I so dealt.

Sathanas.

Welckome, deare darlinge, to us all three
Though Jesus be gone with our meanye (company),
Yet shall thou abyde heare still with me
In paine without ende.

According to old legend, Enoch and Eli were the sole occupants of Paradise, and in ancient paintings and tapestries representing that abode these two only were depicted. In the early English poem on the "Land of Cockayne" the writer jeers at the solitude of Paradise, and at the dull and sorrowful life its two tenants must lead:—

Beth ther no men bot two
Hely and Enok also:
Elinglish mai hi go,
Whar ther wromith men no mo.

Satan, the prominent character and butt of the pageants on the victory of Jesus over hell, wore a vizor made of painted buckram,‡ with an enormous mouth, staring eyes, large nose, and red beard. His dress was of leather trimmed with feathers or horsehair, the feet and hands being cloven or clawed, and the traditional tail appended. In some of the later Mysteries, but more frequently in the Moralities, for he is an indispensable element in both, Satan is accompanied by a sort of buffoon or parasite called the Vice, who represented different abstract but always bad qualities, as Hypocrisy, Infidelity, Gluttony, &c., and who is probably the original of the domestic fool or jester attached to palaces and houses of the great. "It was a pretty part in the old church-playes when the nimble Vice would skip up nimbly, like a Jack-anapes, into the Devil's necke, and ride the devil a course, and belabour him with his wooden-dagger till he made him roar, whereat the people would laugh to see the Devil so Vice-haunted."*

Several pictures of hell-mouth, contemporary with the performances of the Mysteries, are given by Mr. Sharp, and there is no doubt, both from the nature of the subject and from the numerous entries of expenditure in the guild records concerning it, that it was a feature of the scenery upon which neither pains nor cost were spared. Speaking generally, it was constructed as a huge monster's head, dragon-like in shape, with glaring red eye-balls and with open jaws, sometimes worked by a windlass,† and disclosing a murky cavern with actual fire therein,‡ or with flames indicated by red paint or buckram, and filled with a great company of devils tormenting the damned, from whom fearful shrieks and groans arose.

"An hideous hole all vaste, withouten shape,
Of endlesse depth, orewhelmed with ragged stone,
With ougly mouth and grizzly iawes doth gape,
And to our sight confounds itselfe in one." §

* In the Towneley variant, Satan asks Jesus, if he persists in taking "theym alle me fro" to let him out also: "I pray the leyfe me not behynde."

† An old French poem makes one Richart, when about to be hanged, offer a prayer, in which it is said that Jesus brought back all the souls out of hell except one woman, who would stop at the door to give hell a piece of her mind, and who was, therefore, doomed to stay there till Doomsday.—Grimm's *Teut. Mythol.*, 803.

‡ A.D. 1451. Item. Payd for peynttyng of the demon's hede.
Item. Payd for the demon's gment makyng and the stof. vs. iijd. Sharp's *Dissertation*, p. 16.

* Harsenet's *Declaration of Popish Impostures*, 4to, 1603. Sharp, p. 58.

† A.D. 1537. Item. payd for kepynge the wynde, vid.
1557. Item. payd for mendynge the wynde.

‡ Item payd for kepynge of fyer at hell mouthe iiijd. That an earthquake was imitated (although the apparatus used is unknown), probably in the pageants of Hell's Harrowing and Doomsday, is shown by the following entries: 1556. Item. payd for the baryll for the yerthequake. Item. payd for kepynge (attending) the baryll.

§ *Mirrour for Magistrates*, quoted in Hone's *Anct. Myst.*, p. 218.

DUAL BRAIN BUT SINGLE MIND.‖

By Victor Horsley.

UNFORTUNATELY I had no opportunity before yesterday of seeing the criticisms which you have done me the honour of publishing on the lecture which I recently delivered on the "Will and the Duality of the Brain." I hope, however, that, although somewhat late, you will permit me, by amplifying a few points (necessarily only briefly referred to in my lecture), to offer a fuller explanation of them, and so to show that my views of psychical processes were based on sound experimental evidence, and not on that derived from subjective introspection, &c.

By way of preface, let me point out that while you very correctly report me as objecting to the old theory of the duality of the *mind*, you unintentionally misrepresent me as "finding nothing to support" the duality of the *brain*. For I showed in my lecture that that portion of one half of the brain which governs the movements of a limb was independent of the correspond-

‖ I have to thank Dr. Horsley for his very interesting communication. He is quite right in considering that I had formed inexact ideas as to his meaning; which is indeed very nearly that for which I was contending. I had followed an imperfect report in *Nature*.—R. P.

ing portion in the opposite half or hemisphere; in fact, that structurally, and in part functionally, the excito-motor areas should be regarded as dual. I then showed that duality of mental function in the highest sense, *i.e.*, the simultaneous correct performance of two totally different voluntary acts, was impossible provided that such correct performance necessitated the concentration of the attention on each subject.

You quote the case of Prof. Morse, who "could draw simultaneously . . . . . . two different objects with either hand," as invalidating my argument, since such an act would suggest the possibility of the two (highest) cortical - motor areas functionalising at once. Now a good many people, myself included, can perform this feat; but in every instance where I have carefully examined the performance I find that the two pictures are not drawn "simultaneously," in the strictly accurate language of scientific experiment—that there is always a fraction of a second's interval in time between the movements of the hands when these differ at all. We know, further, that ·2 of a second is sufficient interval of time to allow of alternation in the efferent discharge from the two halves of the brain, while I need scarcely add that the ordinary bystander does not appreciate so small an interval of time. As you say truly, it is possible to practise synchronism in actions, and the old schoolboy trick of slapping horizontally the chest with one hand while the other is rubbed up and down is a familiar example of the fact; but this very word "practice" introduces us at once into an absolutely different field of phenomena to those I dealt with in my lecture. It means that an action, at first voluntary, becomes automatic, or, as we should more correctly say, it belongs to a lower grade of simpler, because more often repeated, reflex actions in which the attention is scarcely, if at all, required for their correct performance.

My experiments and statements refer solely to the investigation of purely voluntary phenomena, in which the attention had to be fully concentrated on each problem that was brought before it.

I found, as the result of a large number of experiments (some hundreds) performed by other people as well as myself, that two such efforts of volition could not be performed correctly at absolutely the same moment of time, and the test I used I myself, even after long-continued attempts, never succeeded in overcoming by "practice." May I here remark, that unless Professor Morse was started by a signal, and drew some simple geometrical figures, such as my circle and triangle, his feat scarcely comes within the domain of exact scientific experiment.

Further, you say that we "do not know that when we are trying to do simultaneously two different things, the two different sides of the brain are called into action." Permit me to say on this point that we actually do know (from clinical evidence, some of which I quoted in my lecture) that the *two* halves of the brain are engaged in such actions as my experiment involves, and we now know the parts concerned as well as we do the machinery of the circulation of the blood.

Passing from this part of your article to the question of the evidence we derive from our visual apparatus, I am afraid I scarcely follow you in your remarks about "working the eyes" as analogous to working our hands, for we have, of course, absolutely no voluntary power over our eyes (*e.g.*, in focussing them, &c.). But if I understand you rightly, you would further seek to show that *your* mind must be dual, because it gets simultaneously two different messages from your eyes, owing to their focal distances being different.* This very fact of people seeing perfectly well with one defective eye for so many years without discovering any difference is a fact strongly in support of *my* views, for it is well known that the (single) mind ignores the false evidence from the defective eye. The "double vision," as you call it, of every person is a splendid example of the unity of *function* in the nervous system while the apparatus is duplex in structure. We normally only get one idea from our two eyes—we cannot concentrate our gaze on two objects at once, however hard we try, consequently the attention is never concerned with more than one thing at a time. Further, we now know (from clinical evidence) that, although there is a sight centre in each half of the brain, each is educated simply as its fellow, and therefore if one is destroyed the person knows what he sees just as well as before, showing clearly that although the apparatus is double its function is single. The case of Prof. Ball similarly shows clearly that the brain is dual, that under certain circumstances of disease one sensory perceptive area may be irritated, the other remaining at rest. Such a patient will, therefore, imagine he hears voices talking to him, and he will answer and act accordingly, but the conversation, &c., is alternate—there is no double mental action here, any more than when two persons talk alternately to one another.

I greatly regret that the necessities of a lecture prevented my elaborating my argument, or, perhaps, you would have seen that I am really in perfect agreement with yourself in regarding the brain as a dual machine, my only contention being that in *a purely voluntary act* its function is single.

SURGERY FOR PIANOFORTE PLAYERS.

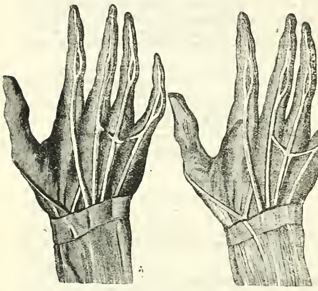
THE most earnest advocates admit that evolution is an extremely slow process: that it produces wonderful results, but that its operations occupy a corresponding amount of time. Certain it is, that the process is not keeping pace with the requirements of modern times, and that the artificial development of the human faculties has of late taken precedence over the natural results of time.

Helmholtz, after making an exhaustive study of the human eye, declared that should he receive an optical instrument of man's making which contained so many defects as the eye, he should be justified in returning it to the manufacturers. But it is these very defects which have stimulated man's ingenuity to find a remedy. So completely has the science of optics come to his assistance that, with the help of the lens in microscope and telescope, he is possessed of an organ capable at once of studying the infinitesimal world represented by a drop of water, or of penetrating the immensity of a solar system. Yet no progress, except, perhaps, in the power of discrimination, is being made with the living instrument, for the eye of the present school-child is probably much inferior in strength and capacity to that of his pioneer grandfather at an equal age.

In other directions, however, man may be improving. His hands, from their constant use of sensitive instru-

* Not quite this. I used double vision only as an *illustration* of brain action; not as an example of it. I certainly did not suppose it was a different *mind* which recognised the imperfect images given by the shortsighted eye.—R. P.

ments and their employment in painstaking investigations, have probably gained a nicety and delicacy of touch which were quite unknown to earlier generations. But even here the progress has not been sufficient to satisfy his wants, and the anatomy of the hand is undergoing a number of modifications due to special treatment or to surgical science. The delicate manipulations of the chemist and physicist or the effective touch of the artist are by no means natural; they result only from the most careful training. In music, whether in using the keys of an instrument, or in working the strings directly, as in the zither or harp, every student remembers the weary practice which has gained him his present proficiency. No amount of devotion, however, seems to have succeeded in overcoming the obstinate weakness of the third or ring finger. Innumerable exercises and daily fingering of the keyboard have left that member but slightly stronger at the end than in the beginning. When, for instance, the middle and little finger are pressed upon the keys to produce a continuous sound, it is almost impossible to bring the ring finger into intermittent



use with a strength sufficient to produce any equality in the tones. The reason is very simple, but rather curious. The *Extensor communis Digitorum* muscle, which moves the ring finger, is connected by lateral or accessory tendons with the muscles of the neighbouring digits, and when these are held down, the accessory tendons prevent the free action of the muscular fibres of the third finger, and hence the clumsy result. These accessory tendons are sometimes found in both hands, often only in one, which in this case is usually the right hand.

Occasionally, the extensor muscle of the ring finger splits at the point of departure of the accessory tendons, and when reunited leaves a button-hole appearance, and now and then these tendons are entirely absent. The possibility of removing this restriction in the use of the ring finger by dividing the accessory tendons suggested itself many years ago, but it is only of late years that the operation has become at all common. Dr. Forbes, the Demonstrator of Anatomy at Jefferson College, and Mr. Zeckwar, the Director of the Philadelphia Musical Academy, have both been much interested in the subject, and have done much to make the operation popular.* By this division of the accessory tendons, the liberation of the ring finger was complete. After such an operation, which is often performed on both hands at one sitting, and without the loss of perhaps more than half a drachm of blood, the finger could be elevated an inch higher above the plane of the hand, and could be used with delightful freedom. There was an entire absence of the sense of exertion which was formerly so painful. Out of fourteen operations which have been performed by Dr. Forbes, all were entirely successful, and in none did any unpleasant results follow. Nor is this resulting liberty at the expense of power in any other direction. The operation does not decrease in the least the ordinary functions of the extensor muscle. Since it can be performed by a surgeon of any competence, it promises in time to become a part of every conservatory course.

As the downwardly projecting point on the helix of the ear is considered by evolutionists to be the remnant of a once-pointed ear, so it is not unreasonable to suspect that the unnecessary tendon may be the last traces of a former webbed formation of hand and foot. That its occurrence is not constant is an undoubted proof of its rudimentary nature. It is quite possible that future students of music will hear with wonder of a binding tendon quite unknown in their own experience.—*Scientific American.*

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

HUNSTANTON AND THE RED CHALK.

(*Continued from p.* 221.)

But the great geological attraction of Hunstanton is the bed of *red chalk* which comes between the lower greensand and the great mass of white chalk above. It is only four ft. thick, but its colour makes it very conspicuous. The colouring matter is peroxide of iron, of which about 6 per cent. is present. Fossils are very numerous, including small *belemnites*, brachiopod shells, and *ammonites*. *Belemnites minimus*—which looks like a tiny lead-pencil—is very common.

The so-called fossil sponge—a branching body resembling the finger of a glove—has been recently shown by Dr. Hinde not to be organic at all, being probably the filled-up burrow of some ancient species of marine worm.

Above this red band we see in the cliff about 40 feet of *white chalk*. As all the strata have a gentle dip to the north-east, we can, by walking along the base of the cliff, examine with convenience a considerable thickness of the rocks. The chalk resting immediately on the red bed is of a cream colour, and is full of the so-called sponge branches; above this is a grey stratum containing many fragments of the shell *Inoceramus;* all higher is the ordinary white chalk. The red chalk can be traced southwards to Snettisham, where it is exposed in one of the great Carstone pits, but further south all traces of it are lost. The keeper of the lighthouse at Hunstanton spends his spare time in extracting the fossils of the rock, and good specimens can usually be obtained from him.

In a northerly direction this red chalk can be traced along the western foot of the Lincolnshire Wolds to Speeton Cliff—six miles north of Flamborough Head—

* The illustrations show respectively the muscular system of the right hand in its natural condition and after the operation has been performed.

in Yorkshire. The exact geological age of the red chalk has been a matter of much dispute. Two geological formations which elsewhere intervene between the chalk and the lower greensand—viz., the upper greensand and the gault—are wanting at, and north of, Hunstanton, and it has been strongly argued that the red chalk is the representative of the gault. The most recent researches, however, go to prove that this unique bed is what it appears to be—the true local base of the chalk; its fossils belonging in greater numbers to species found in the chalk above than to those which characterise the gault elsewhere, though many of the species are common to both these formations. The ordinary white chalk will be seen (*vide* Map, *ante*, p. 221) to form all the country to the east, and Hunstanton is supplied with water from springs in this rock.

Lastly—and of comparatively recent geological age—we come to the marshy beds which cover the older rocks and form a strip along the shore, extending inland from a quarter of a mile to two miles. We can trace them from the railway station southwards to Heacham station, Wolverton, and beyond. In the large pit at the gasworks a thick bed of sand and shingle is worked, which contains numerous marine shells of species still existing, showing that the deposit is one of late geological age. On the fore-shore, a "submerged forest" may be detected when the tide is at its lowest; it is probably an extension of a peat bed which once had a much larger area. At the southern end of Hunstanton cliff, a thin mass of reddish boulder clay rests on the white chalk; and in Hunstanton Park is a winding ridge of gravel and sand, evidently identical with the deposits called "kames" in Scotland and "eskers" in Ireland. The vertical relations of all the strata are shown in Fig. 2, from the oldest—the Kimeridge clay at the base—to the newest—the beds of boulder-clay and alluvium which lie indiscriminately on the upturned edges of any or all of the "solid" rocks.

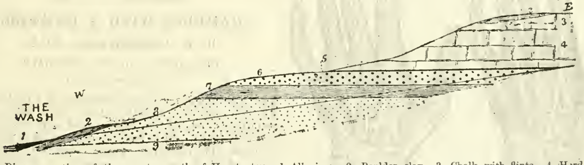


Fig. 2.—Diagram-section of the country south of Hunstanton.—1. Alluvium. 2. Boulder clay 3. Chalk with flints. 4. Hard chalk without flints. 5. Red chalk (thin). 6. Carstone, lower greensand. 7. Clay and loam, lower greensand. 8. Sand, lower greensand. 9. Probable position of Kimeridge clay.

Thus, at Hunstanton, we have first the "solid" geology exemplified by the strata from the *lower greensand* to the *chalk*, and then the "superficial" geology of the surface deposits of boulder clay, gravel, &c. Between the deposit of these two sets of rocks an enormous interval of time elapsed, during which strata, many thousands of feet in thickness, were deposited in other localities. Those who visit Hunstanton will find bracing air and a rolling sea; if they desire a pleasant occupation for their leisure hours, let them turn to the rocks, study their nature, and collect their fossils.

The death-rate of London declined last week to 13·8 per thousand annually, which is stated by the Registrar-General to be considerably lower than in any other week since the publication of the official returns.

THE NEW TELEGRAPH TARIFF.

By W. Slingo.

As, I suppose, every one is aware, yesterday witnessed the introduction of the reduced tariff, as sanctioned by the Telegraph Acts Amendment Bill, which passed both Houses of Parliament last session. It is out of the question to discuss yet the actual effect, either upon the public or the telegraph department, these lines being written some few hours prior to the application of the scheme. There are, however, many features in the preparations which have been made in the anticipation of an increase of thirty per cent. in the amount of work performed that are worthy of attention. It is, as a rule, one of the standing tenets in the management of a Government department, as opposed to a private undertaking, not to anticipate, but only to provide for exigencies as they arise. In a case like the one under consideration, however, such tenets have to be cast on one side, and a broader and more commercial view of matters taken and adopted. There is one danger which beyond and above all others must be avoided, and that is the risk of providing insufficient accommodation. As matters stand, everything is speculation, and there is little warrant for the assumption that there will be immediately an extensive increase in the number of persons using the telegraph. However, the scheme as promulgated and passed by Parliament has received such a considerable amount of attention at the hands of the daily press, that there is little call to enlarge here upon this phase of the subject. Nor could much good result from it, seeing that everything is determined upon and is for the present unalterable. The preparations which have been made to cope with the expected increase are on a most gigantic scale—much more so than would at first sight appear from the amount of money which has been expended, or from the increased expenditure which it is surmised will in the future be incurred. The cost of these preparations so far has been but little over half a million of money, a sum which, expended by the Board of Works, the War Office, or any kindred "spending" department would be regarded as of most insignificant dimensions. The greater portion, too, of this money, notwithstanding the high price which has to be paid for the more or less elaborate instruments and other appliances employed, has been sunk in the purchase and erection of wires and poles. It will be apparent that many thousand miles of wire and many hundred poles have to be erected before any considerable expenditure is involved.

A very fair idea of what has been done throughout the

country may be gathered from a consideration of the changes and extensions pertaining to the Central Office. The spring of last year saw the commencement of the preparations, and at that time the instrument room located on the third floor of the new post office building in St. Martin's-le-Grand contained 720 sets of apparatus, working 685 wires or circuits. These communicated with 230 provincial towns and 424 offices in the metropolitan district. In addition to these there were 49 pneumatic tubes working between the Central Office and several of the adjacent busy offices. The sets of apparatus included 160 single-needle instruments, 425 Morse sounder and printing instruments (of which 188 were worked on the duplex system), 80 sets of Wheatstone automatic fast speed apparatus (these also including 27 on the duplex system), 16 sets of quadruplex apparatus (sending two messages each way simultaneously upon a single wire), and 4 Wheatstone A B C instruments. To work these a staff of 1,730 clerks was employed at various hours of the day and night, the tubes being worked by a staff of 34 attendants.

Within the past eighteen months 172 new wires have been erected, 48 of them being single-needle circuits, 122 Morse sounder or printer circuits, and 2 Wheatstone automatic circuits; 95 provincial towns and 77 metropolitan offices are involved in these extensions. Besides these, many existing circuits have been duplexed, or their carrying capacity in some other way increased; so that at the present time there are altogether 908 sets of apparatus, of which 151 are single-needles, 591 Morse sounders and printers (307, or more than half of them, being duplexed), 57 Wheatstone automatic instruments (all of them duplexed), 18 quadruplex instruments, and 4 Wheatstone A B C instruments. Numerous additions have also been made to the number of pneumatic tubes. The instrument-room as it existed last year was incapable of accommodating so large an increase. It, however, contains a series of long tables, which furnish together 2,885 ft. of desk-space. A new, or fourth, floor has been added, and its single room contains 1,400 ft. of instrument-tables, which are burdened already with 468 sets of apparatus working to the offices in the metropolitan district. The staff has been largely increased, and at the present time numbers nearly two thousand.

The large central hall, on the ground floor of the building, has been appropriated for the pneumatic tubes, the removal of which from the instrument-room increases the possible accommodation there very considerably.

The new wires which have been erected have been, in the main, carried along the high roads, comparatively few extensions having been made on the various railway routes. "Road" wires now span the country in all directions, the recent additions including eighteen wires to the north, pursuing a path known as the east coast route, through Biggleswade, Baldock, Peterborough, Doncaster, Newcastle, &c. One of these wires working to Newcastle is of hard-drawn copper, the cost of which, on account of its thinness, is about the same as that of an iron wire, while the working capacity is considerably higher. Mr. Preece, in a paper read at the recent meeting of the British Association, ventured the opinion that copper responds more readily to rapid changes of electric currents than iron. He suggested that the magnetic susceptibility of the iron is the cause of this, the magnetism of the iron acting as a kind of drag on the currents. The paragraph in last week's "Miscellanea" reveals that the copper wire is capable of transmitting 414 words in a minute, while an iron wire can only carry 345 words.

A second system to the north, known as the west coast route, is also furnished with eighteen wires, the road passing through Aylesbury, Weedon, Stafford, Nantwich, Preston, &c.

Twenty wires now leave London by what is called the Bristol Road Line, passing through Slough, Reading, Marlborough, Chippenham, and Bristol, and thence on to South Wales and the West of England.

Another system leaves London by the South Western Railway, passing along the line to Salisbury, where it "takes the road," and supplies Exeter, Plymouth, Penzance, The Channel Islands, &c. Similar but smaller extensions have been made in the South and South-Eastern divisions, but it is characteristic of the telegraph wires that they all pass through London in underground pipes. Some of them are carried as far as Barnet, others beyond Uxbridge, and others to Hounslow before they "take the open." Such are a few of the details concerning the Central Office, and similar work has been involved elsewhere, altogether, upwards of 20,000 miles of wires having been added to those already existing. It remains to be seen whether the anticipation of an increase of thirty per cent. on the number of messages (24,000,000) annually transmitted will be realised or exceeded.

HUMAN REMAINS FOUND NEAR MEXICO.

By Mariano de la Barcena.

In the month of January, 1884, some excavations were being made, by means of dynamite, at the foot of the small hill known as "*Peñon de los Baños*," some four kilomètres east of the City of Mexico. The excavations were made with the object of quarrying building stone for the Military Shooting School, which is being constructed near the Peñon and under the supervision of Colonel Don Adolfo Obregon. This gentleman, at the beginning of January, was informed that among the rocks loosened by the dynamite some bones were to be found, and he accordingly collected and delivered them to the Minister of Public Works, Don Carlos Pacheco, who appointed the writer to make a study of them. The preliminary examination being made, I presented them to the Mexican Society of Natural History, giving at the same time public notice of so important a discovery.

Some days afterwards I explored the formation in which the bones were found, continuing my studies with the co-operation of Don Antonio del Castillo, professor of geology, whom I invited to take part in my investigations; both making up a report which has lately been published in Mexico.

The human remains are firmly imbedded in a rock formed of silicified calcareous tufa, very hard and of a brownish-grey colour. The cranium, with the lower and upper maxillæ and fragments of the collar-bone, vertebræ, ribs and bones from the upper and lower limbs are exposed. The bones lie in disorder, proving that the rock in which the skeleton was found suffered an upheaval before consolidation, a circumstance which an examination of the ground further verifies. The bones present a yellowish appearance, and the characteristic aspects of fossilisation, it being noteworthy that

they are not coated with layers of the calcareous rock as is observed in the recent deposits, but are firmly imbedded in the stone, which also fills the cells of the tissue.

Several distinct formations and rocks are seen in the locality where the bones were found; towards the centre rises the small hill, "*del Penon*," consisting of volcanic porphyries; on the base to the north there appear first a clearly recent formation made up of vegetable earth, marl, and ceramical remains, which in the upper part are modern, and in the lower belong to the Aztec ceramics. Under this recent formation are the calcareous layers in which the human remains were found.

These layers crop out with a rise toward the northern boundary, forming the end of an esplanade which surrounds the hill, and is three mètres above the actual level of the waters of Lake Tezcoco. The layer of hardened rock does not extend with regularity the whole distance from the before-mentioned edge to the foot of the hill, some intervening spaces occurring in which this rock does not appear, the resulting hollows being filled with recent ground. This circumstance, as well as the appearance of the layers of calcareous tufa, prove that this rock was upheaved after the deposit of the human bones, by the igneous rocks which crop out in the neighbourhood of the hill, forming dykes. This upheaval is also verified by the numerous small veins which are found in different directions on the ground.

In order to clearly establish the age which the deposit of the human bones might have, the best scientific method would be to find some animal fossil remains in the same formation which would distinctly mark the age of the layers of that calcareous rock; but until now, notwithstanding the many searches made, it has not yet been possible to find any traces of extinct animals; neither has there been found any vestige of ceramics or other remains that might indicate that these rocks were clearly modern, as among them the only things found were the human bones, roots converted into menilite, and some small indeterminable lacustrine shells formed by the same calcareous substance. These shells belong to genera which have lived in Quaternary as well as present waters, it having been impossible to determine their species on account of the bad state of preservation in which they were found.

In the region to the south of the hill more modern calcareous rocks are seen, and thicker deposits of recent ground with remains of Aztec ceramics.

Not being, therefore, able to utilise the palæontological data for determining the age of these calcareous layers, we must fall back on the inspection of the ground.

Two facts seem at once to reveal that, even supposing the formation to belong to the present age, it must be of remote antiquity. These facts are: the elevation of the ground above the actual level of the Lake of Tezcoco, and the remarkable hardness of the rock in which the bones are found, different from the other calcareous rocks that contain remains of ceramics or roots of plants clearly modern. The upheaval of the lacustrine layers which contain the human remains might have taken place through the diminution and retirement of the waters of the lake, or by the upheaval of volcanic rocks.

In the first case it could have been occasioned either by a violent filtration of the water, or a slow evaporation; but nowhere in the valley of Mexico are any traces to be found of a crack or opening through which the waters could have escaped, and which ought to appear outside of the present level of the lake, as, if it were below, all the water would have disappeared. If the lowering of level was due to evaporation, a theory which would be more admissible, because from the time of the conquest of Mexico to the present the submerged surfaces have notably diminished, the time necessary to have elapsed in order that the level of the lake might fall three mètres to its present one must have been very long. What is most probable is, that the upheaval is due to volcanic action; for, although until now no basalt has been discovered immediately underneath the place occupied by the hardened layers, yet dykes of that rock are to be seen in different directions at the foot of the hill, and even the volcanic masses which constitute it are found upheaved and inclined, demonstrating the succession of geological phenomena in that vicinity.

Let us now trace the origin of the silicified calcareous rock in which the bones were found, and which is different from the majority of the lacustrine rocks which occupy the valley of Mexico, these latter being, for the most part, thick and extensive layers of pumice, tufas, marls, volcanic ashes, clays, and alluvions.

In order to proceed with more certainty in this investigation, I compared the calcareous rock in question with those which resembled it most from other parts of Mexico, and found it could only be considered similar to those which are clearly of a hydrothermal origin.

The hot-water spring which exists in the eastern part of the hill del Peñon forms sediments somewhat similar to the silicified calcareous tufa; but these are on a small scale, and their formation is so slow as to preclude the belief that this spring could have filled all the immediate surroundings of the hill with deposits of such magnitude. What is most probable is, that in remote times there were great emissions of mineral thermal waters through different fissures, and in several directions, whose appearance was simultaneous with the basaltic masses that form dykes at the foot of the hill, as in the faces of the rocks sedimentations similar to the referred ones are perceived, there being, furthermore, many small veins which cut through the basaltic masses and even the calcareous rock.

By this it is seen that a series of vocanic phenomena must have taken place in that spot, beginning before the human remains were deposited, and which further continued when the material which received them was but little consolidated.

The succession of these phenomena took place, without doubt, in the following way:—

1. Emission of thermal waters and appearance of basaltic rocks, upheaving the masses that formed the hill. These waters mixed with those of the lake which surrounded the hill and extended over a large area of the valley of Mexico; the calcareous deposits gradually accumulated around the hill, and being still soft the human corpse was deposited upon them.

2. When the bones were already imbedded in the lacustrine deposit there came a new volcanic upheaval which raised this deposit, as the higher level which it now occupies proves, and the disorder in which the bones of the skeleton appear.

3. In the gaps which were left after this upheaval, modern lacustrine deposits were formed, which increase even at the present time.

It is to be remarked that in other parts of the valley of Mexico in connection with the Lake of Tezcoco, isolated deposits of this silicified calcareous rock are seen, showing that the volcanic upheaval extended over a large surface, and that the thermal waters appeared several times. One of these deposits is to be found at the height of two mètres above the present ground among rocks of the hill del Tepeyac, north of the City of Mexico.

The geological circumstances of the event once determined, and notwithstanding that the palæontological data are wanting that might mark with precision the relative age of that deposit, it is to be believed that it must be of remote antiquity, considering the circumstances which the mentioned rocks present, as well as the geological phenomena which have there taken place and of which no notice is given in the hieroglyphics or traditions of the ancient Mexicans.

This consideration alone is enough to believe that the man of the Peñon is pre-historic. The odontological characteristics indicate that this man belonged to an unmixed race, the teeth being set with regularity and corresponding perfectly the upper with the lower. They present the peculiarity besides, that the canine teeth are not conical, but have the same shape as the incisors; a peculiarity which has been observed in other teeth found in very ancient graves of the Toltecs.

The size and shape of the bones of the limbs are those corresponding to a man of ordinary stature, and from the appearance of the teeth the man must have been about forty years old.

The greater part of the cranium having been destroyed, it was not possible to determine its diameters and thus classify it. The stratigraphical and lithological characteristics of the ground seem to indicate that the formation belongs to the upper Quaternary, or at least to the base of the present geological age.

It may as well be remarked that at the foot of the steep slope of the Tepeyac hill, near the place where the calcareous sediments are to be seen among the rocks of the hill, as was previously mentioned, some excavations were made, and Professor Don Antonio del Castillo found various bones of Quaternary animals enveloped in a calcareous rock similar to that of the Peñon. The distance between this hill and the Tepeyac is nearly three miles.

The excavations continue at the foot of the hill del Peñon, with the object of quarrying building stone, and this will allow in the course of time some other data to be discovered which will clearly mark the geological age of the event; a tooth of a mastodon or an object of the present age would at once be the landmark assigning it a fixed page in the history of the earth. The authenticity of the fossil is not only determined by the report of Señor Obregon and the identity of the rock which contains the remains with the blocks that are being at present quarried at the foot of the hill, but I, myself, have determined this authenticity, having found part of the human remains still imbedded in the ground rock.

I will conclude by mentioning other facts that indicate the antiquity of man in the valley of Mexico. Twelve years ago, in executing some works for the drainage of the valley, in the direction of Tequisquiac, numerous deposits were discovered belonging to Quaternary animals, such as elephants, mastodons, glyptodons, &c., and among one of these deposits a fossil bone was found carved by human hand and imitating an animal's head. Unfortunately no care was taken to determine if it was found simultaneously with the bones of the Quaternary animals. The appearance of the carved bone, and of the cuts and incisions which it has, denote a remarkable antiquity, and it has characteristics of fossilisation. Two years ago I discovered some remains of ancient ceramics in the pumice tufa which is under the basaltic lava formation found in the south-eastern part of the valley of Mexico; the lava occupies a large area, and in some points its thickness is over two mètres. No tradition makes any mention of this volcanic cataclysm before the existence of man in the valley of Mexico.

These are, at present, all the data I can give relative to the man del Peñon. On my return to Mexico I will continue with a further investigation of the ground where the discovery was made, and will communicate anything new that may be found, in order to determine the anthropological importance which these human remains may have.

FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*α*, the *Pole Star*).
2. *Draco*, the *Dragon* (*α*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*α*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*α*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*α*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*α*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*α*, *Vega*).
15. *Cygnus*, the *Swan* (*α*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*α*, *Aldebaran*; *η*, *Alcyone*, chief Pleiad).
21. *Gemini*, the *Twins* (*α*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*α*, *Regulus*).
24. *Virgo*, the *Virgin* (*α*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*α*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*. the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*α*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*α*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*α*, *Alphard*).
36. *Crater*, the *Cup* (*α*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*α*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*α*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*α*, *Sirius*).
45. *Argo*, the *Ship*.

The Satellite of Neptune.—From similar observations of Neptune's satellite Prof. Hall obtains for Neptune a mass

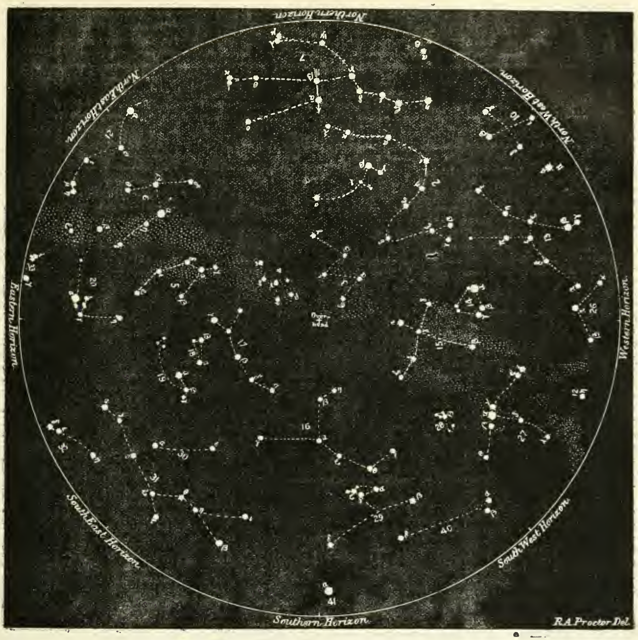
$$=\frac{1}{19092 \pm 64}$$

computing the mean distance of the satellite at 16″·2699.

$$N = 184°·314 \pm 0°·1233$$
$$I = 120·052 \pm 0·1019$$
$$\text{Period} = 5·876839 \text{ mean solar days.}$$

Newcomb's value $= 5·8769$ so that the correction is very slight. Prof. Hall found the satellite an easy object with the great refractor (26 inches in aperture) when more than 10″ from Neptune. He looked in vain during 1881-1884 for any other satellite.

The Satellites of Uranus.—From a careful discussion of the movements of Oberon and Titania, the sa-



NIGHT SKY FOR OCTOBER (First Map of Pair),

Showing the heavens as they appear at the following hours:—

At 10 o'clock.........October 7.	At 9¼ o'clock.........October 19.	At 8½ o'clock.........October 30.
At 9¾ o'clock.........October 11.	At 9 o'clock.........October 22.	At 8¼ o'clock.........November 3.
At 9½ o'clock.........October 15.	At 8¾ o'clock.........October 26.	At 8 o'clock.........November 7.

tellites of Uranus, Prof. Asaph Hall, of the Washington Observatory, deduces the following results:—

$$\text{Mass of Uranus} = \frac{1}{22682 \pm 27}$$

The mass of the sun being the unit.

Prof. Hall obtained results so closely accordant as regards the position of the planes of the orbits of Titania and Oberon, that he thinks we may fairly regard these planes as coincident. He obtains for this common plane the following elements of position, N being the longitude of the ascending node, I the inclination, t the number of years since 1883·0:—

$$N = 165^\circ{\cdot}812 + 0^\circ{\cdot}0142t$$
$$I = 75{\cdot}300 - 0{\cdot}0014t$$

The values of the mean distances a, assumed in his computations were for

Oberon, $a = 41''{\cdot}15$
Titania, $a = 31{\cdot}46$

Careful search was made with the great refractor for new satellites during the favourable oppositions of 1881–1884, but none were found.

ROPE RAILWAY AT GENOA.*

THE construction of a rope railway on the Agudio system, at Genoa, from Balzaneto to the Madona della Guardia, has been sanctioned by the Minister of Public Works. One of the most important features in this scheme, and in which it differs from the line now in operation, on the Agudio plan, from Turin to the Superga, is that no stationary engine will be required, as Mr. Agudio, the engineer, intends utilising the power of the same locomotive that will be employed for bringing the train from Balzaneto to the foot of the incline to the Sanctuary, a vertical height of 700 mètres (2,296 feet). This power will be transmitted, as is the case with the Superga line, by an endless wire rope, driven at a high speed, to a specially-constructed apparatus, or "locomotore," which receives the energy thus conveyed to it, and utilises it for the direct haulage of the train. In this way, one of the principal drawbacks in the application of this system will be avoided, as the traffic on such lines is very variable, and the expense of keeping a stationary engine of at least 250 horse-power forms a serious item in the working expenses, and especially so on week-days or during the winter months, when the traffic must be small. The locomotive, which will weigh about twenty-six tons, will, after having brought the train from Genoa to the foot of the incline, be disconnected, and taken on to a siding, where, by a suitable arrangement, it will be lifted off the rails, and its driving-wheels will bear on and be supported by other wheels revolving in fixed bearings placed below the level of the rails. The motion of the driving-wheels of the engine will be thus communicated to the wheels below, which, being connected by suitable gearing with the pullies for driving the rope, will thus transmit the energy developed by the locomotive to the "locomotore," or driving-car attached to the train, and use it for hauling up the train.

Under these conditions, the locomotive will, whilst working as a fixed engine, no longer have a large proportion of its power absorbed in drawing its own dead weight, and, therefore, if only 150 horse-power are utilised whilst drawing the train, consisting of three passenger carriages, containing 150 persons, its useful power will easily be increased to 250 horse-power when it no longer has a dead weight of twenty-six tons to drag.

* Society of Arts Journal.

LIVE-BURIAL.

By Dr. W. Curran.

THE origin of sacrifice, human and otherwise, is lost in the dim obscurity of the past. When first we hear of it in connection with the sacrificial acts of Cain and Abel it is spoken of as a familiar thing, a matter of course, and its previous enactment or existence is taken for granted. It was subsequently practised as a part of the ceremonial observance or law of the Jews, and other primitive or pagan worships, and it is now, as every one knows, the mainstay and corner-stone of the Greek, Roman, and other Christian denominations or rituals. That human beings were formerly sacrificed to appease the anger of some offended god, or remove such diseases as leprosy, small-pox, epilepsy, &c., is tolerably certain. They were also sacrificed for the purpose of staying the ravages of the plague, enabling their votaries to overcome their enemies in battle, and bring back fertility to their exhausted fields or flocks.* It would not, indeed, be easy to define the conditions under which they were *not* resorted to at one time or another by different tribes or peoples, and the whole subject is learnedly discussed in the "Victimæ Humanæ" of Jacob Gensins, of Groninghen, to which I am indebted for some of the illustrations recorded below. It is certain from this and other sources that the enforced or voluntary live-burial of human beings formed no inconsiderable part of these cruel rites.

That interruption to the true course of conjugal love that is caused by the death of the husband was probably the first cause of these immolations. The bereaved wife could not or would not survive her husband. The family crone or the family priest was at hand to encourage her in the practice of this laudable vow or wish; and Pomponius Mela expressly tells us that the wives of the polygamous Scythians contended amongst themselves as to which of them should first be buried along with her lord and master. Herodotus and Lucian are equally explicit in their ascription of a similar spirit of contention to the wives of the Thracians and Thrausians; and it is now generally understood that the original idea of saté was simply that of sending a favourite wife to keep company with her husband after death. When the ancient Scythians buried a king—says Mr. Wheeler†—they strangled one of his concubines and buried her with him, together with his cup-bearer, groom, &c. Amongst the Thracians there existed a still more significant custom. Every Thracian had several wives, and whenever a man died a sharp contest ensued between his wives as to which of them he loved the best. She who by her vows or wailings enlisted the largest amount of sympathy or support from the assembled crowd of courtiers won the coveted prize, and marched exultingly to her horrid doom.

Peter Martyr — who had special opportunities of knowing the facts—tells us that the ancient Americans buried the living babe in the same grave with its dead mother; and Saxo Grammaticus informs us that an acquaintance of his, one Asmundus, had himself shut up in the tomb that covered the remains of his friend Avitus. Similar stories are told by travellers of the struggles that took place for this privilege among the retainers of certain African kings. The main incident of the play of "The Illustrious Stranger" turns upon an episode of this kind; and it is, I fear, pretty certain that similar scenes may still be witnessed at the Court of Dahomey and elsewhere in the interior of that dark continent. Many savage peoples also buried their captive enemies alive, especially so if they had previously lost several

* Another and, I believe, an erroneous motive has been assigned by Mr. John Morley for the employment of this practice among savages. Alluding to the treatment of Sir Stafford Northcote by Lord Salisbury, he is reported in the *Standard* of July 14th last, to have said that, "when it was conceived by these savages that their old people had lived long enough, or, if they had the indelicacy not to recognise this fact themselves, and refused to make a choice between strangulation and being buried alive, then, without further ceremony, the tribe took the matter into their own hands" and buried their recalcitrant old kinsfolk alive. They did no such thing, Mr. Morley. They were not such fools as you take them to be, and such an exhibition of disinterestedness, decency, or humanity would be scouted by your Fuegian, Figian, or other "aboriginal" savage of that type. They would eat them instead; and I am not sure that civilisation has yet hit upon any more economic expedient for disposing of the dead, or more sanitary mode of sepulture than this is.

† "The History of India from the Earliest Period," vol. i. pp. 69-70. See also Ibid, vol. iii. pp. 89-91, in the same direction.

friends or relatives; and we know from Livy, Pliny, Juvenal, and a host of other Roman writers, that the vestal virgins who committed themselves, *vivae pro victimis obruebantur, ut hoc defossione scelus hoc (incastitatis) expiaretur; et divinae irae reatus hoc flagitio contractus solveretur.*

Herodotus further mentions that Amestris, one of the wives of Darius, who would appear to be losing her hold through advancing years on the affections of that monarch, caused fourteen of the children of her principal nobles to be buried alive, "ad referendam," as this writer quaintly puts it, "pro se gratiam deo;" and Porphyry ascribes a similar custom to an Arabian tribe, which he calls the Deomactii. Readers of Horace will remember that his witch, Canidia, buried the boy she had stolen up to his chin, so that she might be thus the better enabled to extract a love-potion out of his marrow and liver; and, describing the eunuchs of Peru and the houses in which the so-called "Daughters of the Sun" were secluded, old Purchas says (his "Pilgrimage," p. 883) that "if any of the Mamacomas—the young virgin nuns—or Aellas were found to have trespassed against their honour, it was an inevitable chastisement to bury them alive, or to put them to death by some other cruel torment."

Dwelling on some of the strange scenes he witnessed on his arrival in India, soon after our first settlement at Surat, Dr. John Fryer says ("An Account of India." London: Trübner. Page 378) that, "at Hubly, in this kingdom, are a cast called Liugints, whose wives . . . . are set in the same pit (with their dead husbands), covered up to the shoulders with mould; who, after ceremonies performed, have their necks wrung round, and the pit filled up with earth immediately." And saté would, after all, appear to be an improvement on this. For there is no doubt that saté was in many cases a purely voluntary act, inasmuch as the doomed widow might have escaped with life if she chose. But then she would probably have become an outcast, or worse; and it is at any time a case of Hobson's choice between live burial and live burning. Superstition of the grossest character could alone reconcile a frail woman to such a dreadful alternative or ordeal; but it is, we know, capable of even worse things than this; and "the facility with which men and women persuade themselves of a religious sanction for what they wish to do, however cruel and iniquitous, is not," says General Sleeman,* "unhappily, peculiar to any class or any creed."

Touching its enforcement as a punishment as contradistinguished from its ceremonial or sacrificial uses, the record is necessarily more scanty. I have only been able to collect a few cases in point, but many others must doubtless have escaped notice carent quia vate sacro, and the perpetrators of such hellish barbarities are either unknown to fame or they shrink from publicity. Moreover, live-burial as a punishment is now unknown to the law of any civilised country, and so we have to look to the past rather than to the present for such illustrations of this death penalty as are now available. Enumerating the obstacles Mahomet had to encounter and surmount, Sale says ("A Preliminary Discourse to the Koran," Tegg's ed., p. 17) that "one Abu Kabûs, King of Hira, ... in a drunken fit, ordered two of his intimate companions, who, overcome with liquor, had fallen asleep, to be buried alive," and live-burial was formerly —may still be, for all I know to the contrary, the penalty of red-handed homicide or murder in parts of Nepal and Tibet. Fr. Gruber, the Jesuit, as quoted by Mr. Clements Markham,* is my authority in regard to the former, and as to the latter Horace de la Penna, another Jesuit, says that "if the death of one of the parties (to a fight) is immediate on the quarrel, they—the neighbours or authorities—take and bind the murderer to it, and after twenty-four hours bury both the dead and the living together."

Coming nearer home, we find a very similar state of things. Thus, describing the customs of Ladak—now in Cashmere territory—Cunningham† says that, "in cases of killing in a scuffle in Ladak, the custom . . . was to bind the homicide to the corpse, and at the end of twenty-four hours to cast the living and dead together into the river"; but if this was not at hand, a hole in the ground took its place. Punishment in the East must, if it would be effectual, be short, sharp, and decisive, and those French or Italian adventurers—Avitabile,‡ Ventura, &c. —who kept the turbulent Punjabees in order for so many years under Runjeet Sing, thoroughly understood this necessity, and acted up to it. But this is not the place for a review of their *modus operandi*, and dwelling on the spirit and determination with which the once famous Begum Sumroo had raised herself from the doubtful position of a dancing-girl at the Mogul Court of Delhi to the musnud (throne) of Sirdhana, near Meerut, General Sleeman says—"The Rambles and Recollections of a Bengal Officer," vol. ii. p. 385—that, "while she was encamped with the army at Muttra, news was one day brought her that two slave-girls had set fire to her house at Agra, in order that they might make off with their paramours, two soldiers of the guard she had left in charge. These houses had thatched roofs, and contained all her valuables, and the widows, wives, and children of her principal officers. The fire had been put out with much difficulty and great loss of property, and the two slave-girls . . . were brought out to the Begum's tent. She had the affair investigated in the usual summary form; and their guilt being proved to the satisfaction of all present, she had them flogged till they were senseless,

* "A Journey through the Kingdom of Oude," vol. ii. p. 250.

* "Narratives of the Missions of George Bogle and Thomas Manning," pp. 299–300 and 325.

† "Ladak," by A. Cunningham, p. 263, and describing the punishments inflicted on criminals and others in Tibet, Mr. A. Wilson says—"The Abode of Snow," pp. 181–2—that "one mode of putting to death, which is sometimes inflicted, struck me as the most frightful instance of diabolical cruelty I had ever heard of. . , . The criminal is buried in the ground up to the neck, and the ground is trampled on round him sufficiently to prevent him moving hand or foot, though not so as to prevent him breathing with tolerable freedom. His mouth is then forced open, and an iron or wooden spike, sharpened at both ends, is carefully placed in it so that he cannot close his mouth again. Nor is the torture confined to leaving him to perish in that miserable way. Ants, beetles, and other insects are driven to take refuge in his mouth, nostrils, eyes, and ears." And it would appear from Bishop Bigandet's "Life or Legend of Gaudama, the Budha," p. 243, as if live-burial was employed as a regular punishment, for even trivial offences, in the early days of that otherwise mild and tolerant creed—Buddhism.

‡ An old inhabitant of Peshawur assured me that he had more than once seen as many as six corpses suspended by the neck of a morning on one of the bastions of that fortress by this man's orders; and 'tis certain that he (Avitabile) required a whole regiment for his escort, whether he went abroad or stayed at home, so much was he hated or feared. Sir Herbert Edwards "heard ("Life of Sir Henry Lawrence," vol. i., p. 291.) citizens of Peshawur tell how a follower, who had insulted some member of the General's harem, was forthwith ordered to be hurled down from the top of a minaret." The wretch was hurled, but contrived somehow, when half-way down, to seize a projecting cornice, and scream thence to his punisher for "mercy for the sake of God," Avitabile, unmoved, replied, "God may have mercy on you if he likes; I'll have none; throw him off the ledge." And thrown off he was accordingly.

and then thrown into a pit dug in front of her tent and buried alive."

Local tradition adds that she slept over their grave the following night; but this story lacks confirmation, and she had not, I believe, conformed at this time to Christianity. Whether she had or not would make no great difference, for Christianity has not changed the hearts of women any more than it has those of men in this respect, and it may be doubted if Paganism or any other cause has produced worse specimens of feminine humanity than are to be found in the familiar pages, to go no farther, of Finlay and Froude. However that may be, there is not much to choose between being buried alive, or being blinded or burnt alive; and we know that these mild processes were rather freely enforced for conscience or empire's sake, by more than one of our model Christian heroines. Live-burial would also appear to be preferable as a punishment to those cruel half-hangings and quarterings that were sanctioned by our laws down even to a recent period, and the Begum's summary action will bear favourable comparison, any day, with that of her Christian sister, Brownrigg, who

> . . . . whipped two female prentices to death
> And *buried* them in the coal hole.

Thirty-seven lighthouses have been built round the island of Newfoundland during the present century, of which eleven have been erected during the last seven years. Two new lighthouses are in course of erection, and the estimates for two more have been voted.

Wire Gauges.—A motion was brought forward at the recent convention of the American Telephone Exchange Association to adopt the English standard wire gauge, in order to be in uniformity with European nations. It met with strenuous opposition from several members, who thought the American gauge was all that was required; but it was eventually agreed to.

Death of Mr. Walter W. Weldon.—Mr. Walter W. Weldon, F.R.S., Chevalier of the Legion of Honour—one of the five men, and the only foreigner, whom the French Société d'Encouragement has deemed worthy of its "grand medal"—died on Sunday, at the age of fifty-three. He had been for some time afflicted by mental disorder, due, it is said, to over-work. To him the country is indebted for the process by which alone bleaching-powder is now made. The peroxide of manganese employed to liberate chlorine from the hydrochloric acid obtained in the first step of the soda manufacture was formerly thrown away. By a very simple process Mr. Weldon recovered from ninety to ninety-five per cent. of the manganese in a form available for renewed use, and thus saved nearly £6 on every ton of bleaching-powder made, quadrupled the total manufacture, made the industrial world the richer by some three-quarters of a million sterling per annum, and, as the French chemist, J. B. Dumas, publicly observed, "cheapened every sheet of paper and every yard of calico made in the world." No name was better known among the practical chemists in England, France, and Germany.

The Mineral Wealth of China.—Baron von Richthofen, who some time since explored fourteen of the nineteen provinces into which China is divided, has contributed to a Vienna review some interesting information as to the coalfields of the Celestial Empire. He says that while there is not a single province which does not contain more or less coal, the principal fields are in the southern half of Chan-si, in the south of Hunan, and in the west of Chan-Ting. The coalfields of Chan-si have an area of 14,000 square miles, and contain 730,000,000,000 tons. Taking the annual consumption of coal in the whole world at 300,000,000 tons, this coalfield alone would last 2,433 years, and in quality it is the best anthracite, superior even to that of Pennsylvania. In the south-east of the same province is another coalfield almost as extensive but the coal is more bituminous in quality. It is very easily extracted, and Baron von Richthofen adds that the Catholic missionaries at Tai-yuen, the capital of the province, pay only 3s. for a ton at the pit's mouth, though the cost of carting it to Tai-yuen is about double as much. He estimates the total extraction of coal at 2,965,000 tons for the whole of the eighteen provinces and Southern Mandchuria.

Gossip.

By Richard A. Proctor.

A correspondent asks how the distance of the sea horizon may be determined,—quoting the rule to the number of feet add half, the square root of the sun represents the distance of the horizon in miles. It is better to double than to add half; for owing to refraction six inches is much nearer the average depression for one mile than eight inches.

Assuming the optical depression per mile to be but six inches, what is the curvature of the light rays due to refraction? It is clearly such as to produce a deflection of two inches per mile. Wherefore, says another correspondent, if the earth were so much larger that the geometrical depression for one mile were only two inches the line of sight would bend just enough to correct the depression and we should be able to see right round, or all over the surface of the earth supposed to be smooth. "May not Satan," he proceeds, "when he arranged the panoramic view from an exceeding high mountain (unknown) have brought the whole world into view this way, by altering the refractive power of the air, so that the bending just corrected the geometrical depression?"

That is the sort of question continually poured in. One would imagine that the fallacy could deceive no one, and that the best reply would be,—"Oh bosh"—like the worthy bishop in the "Bab Ballads." But that answer, or one to that effect, was not held to be satisfactory. Truly the misapprehensions men make, even men of decent average intellect, about matters optical, are amazing. Here, for instance, is a man imagining the visual line, or a ray of light, capable of curving round a globe so as always to be at the same elevation, or where the air has the same density, though bending or refraction can only arise as the ray or visual line passes from air of one degree of density to air of a different degree!

Satan, then, could not be allowed to arrange any such unscientific trick, either now or in the old times when men were safe at any rate from Editors of Knowledge and from scientific lecturers.

By the way, it was *not* Satan, but the author of one of those "reconciling" books who tried to show that refraction might bring the sun into view round a whole hemisphere. This, of course, would bring him into view all round, or make him appear like a ring round the horizon, just as he would (*pace* Mr. Williams) to an inhabitant of the moon, if such there were, during a central eclipse of the sun by the earth.

Talking of odd mistakes, Mr. Williams's notion that at such a time two beams of sunlight, one going round one side of the earth, and the other going round the exactly opposite side, cross on the line joining the centres of the earth and moon *as at a focus*, is an odd one—though natural enough perhaps. I wonder how many readers of these lines will appreciate my remark on this point, that these two beams have as much connection with each other, so far as coming to a focus (properly so called) is concerned, as the last ray of the setting sun to-day with the first ray of the rising sun the day after to-morrow.

Reviews.

SOME BOOKS ON OUR TABLE.

Evolution without Natural Selection. By Charles Dixon. (London: R. H. Porter. 1885.)—The reader who takes up Mr. Dixon's little book in the hope or expectation that it is written to confute the imperishable theory of Charles Darwin, will find himself curiously mistaken. Rather does its author set himself to supplement that theory, and to clear up certain difficulties expressed in connection with it by its immortal originator. Particularly does Mr. Dixon insist upon the effect of isolation in the origination of species, and, postulating a primæval Polar centre, whence life radiated, shows how this factor would operate in the production of new forms of life. Climatic influences, sexual selection, and interbreeding, are dealt with in succession as originating species. *Ne sutor ultra crepidam*, and our author has done wisely in drawing his illustrations from birds alone, he being a professed ornithologist. There is much in this small volume worthy of perusal by the philosophical naturalist.

Wild Life in Canara and Ganjam. By Gordon S. Forbes. (London: Swan Sonnenschein & Co. 1885.)—In a modest and unassuming way, and without the slightest effort to be fine or flowery, Mr. Forbes gives us his experiences gained as magistrate and collector successively in Canara and Ganjam, taking mainly the form of hunting adventures. His hunting stories differ in no material respect from those of the multitude of Indian shikaris who have given their adventures to the world, but incidentally he furnishes, pleasantly enough, information as to certain districts and their inhabitants with which the ordinary English reader is far from being familiar. The illustrations, executed in some form of chromography, show skies, seas, and lakes so blue, grass and trees so green, and sunsets of such unparalleled brilliance, as would almost have made Turner tear his hair with envy.

Programme of Technological Examinations, Session 1885-86. City and Guilds of London Institute for the Advancement of Technical Education. (London: Gresham College.)—So far as we have been able to test this Syllabus, the course of study prescribed, and the character of the examinations proposed to be held in the various subjects to the teaching of which the Institute is devoted, would seem to be well chosen and most efficient. It is much to be hoped that the percentage of rejected candidates will be very much in defect of what it has been in the case of the examinations so far conducted by the Institute since its formation.

Handbook of Practical Telegraphy. By R. S. Culley. Eighth Edition. (London: Longmans, Green, & Co. 1885.)—The fact that this work has reached its eighth edition is proof positive of its general utility and excellence. The new edition, as compared with the preceding one, is almost a new book, a large portion of it having been re-written, in order to bring the handbook up to date. The recent improvements in quadruples and fast-speed automatic apparatus are ably dealt with; indeed, to get as near as possible to the existing state of affairs, the author, who long since was compelled by his advanced age to sever himself from actual work, has secured the invaluable aid of Messrs. Graves, Preece, and Chapman. Although the book still remains to be written which shall teach the telegraphist all he ought to know, Mr. Culley's effort is far and away superior to anything else in the market, so far at least as the British operator is concerned.

Manual of Telegraphy. By W. Williams, Superintendent of the Indian Government Telegraphs. (London: Longmans, Green, & Co. 1885.)—The great difference between this and the work previously noticed, affords considerable evidence of the extent of the field which will have to be covered by the author who succeeds in embracing the whole subject of telegraphy in a single work. The volume under notice has been written by order of the Director-General of Telegraphs in India, and is based on the substance of the papers on technical subjects set by the author at the General Examinations of the Indian Telegraph Department. These subjects embrace a general description of the various instruments, batteries, and circuits which the telegraph official may be called upon to deal with; faults which may be met with, and their remedy; testing, and the electrical phenomena which interfere with communication. The work affords a means of self-education, and forms a text-book of ready reference. A study of the manual cannot fail to reveal to the reader something of the different considerations under which telegraphy is carried on in India as compared with England. We should have been pleased to see a few more illustrations; but, all things taken into consideration, the work is a highly creditable one, and worthy of study by every one interested in the subject.

In the Watches of the Night. Poems (in eighteen volumes). By Mrs. Horace Dobell. Vols. 7 and 8. (London: Remington & Co. 1885.)—If Mrs. Dobell has sometimes been dismal and depressing in previous volumes of this series (and she has on occasion been *very* dismal indeed)—in those before us she is really and truly "like Niobe, all tears." Her verse trickles smoothly along, but in her endeavour to be pathetic she simply becomes lachrymose—a very different thing indeed.

The Strange Story of Eugenia, &c., by Miss H. H. Coode. (London: Griffith, Farran, Okeden, and Welsh).—Sensational as are the three stories of which Miss Coode's little book is made up, they never degenerate into vulgarity, nor into the mere blood-and-murder type of narrative, which but too often forms the modern substitute for the quieter and more decorous novel of our fathers. In the second tale, "The Necromancer's Hand," a weird idea is very cleverly worked out, and the end is decidedly "creepy." Readers in search of a sensation might do much worse than invest the modest price of Miss Coode's *brochure* in its purchase.

We have also on our table *The Journal of Botany*, *Ciel et Terre*, *The Sidereal Messenger*, *The Medical Press and Circular*, *Bradstreet's*, *The Sanitary News*, *The Tricyclist*, *Wheeling*, *The Country Brewers' Gazette*, *L'Echo* (with two pages devoted to science), *Electricité*, *The American Naturalist*, *Walford's Antiquarian* (as usual, full of matter of interest for the archæologist), *The Church of England Temperance Society and the Impending Electoral Contests*, *Gossip* (contains a column of "Science Jottings"), *Our Monthly* (Rangoon), *The Little One's Own*, *Progress*, *The Leeds Mercury*, *William Wesley & Son's Natural History and Scientific Book Circular*, T. B. Sprague's *Report on the Royal Liver Friendly Society*, and *Barr & Son's Catalogue*.

It is estimated that the number of passengers carried by all the railroads in all parts of the world in 1882 was 2,400,000,000, or an average of 6,500,000 a day.

TO CORRESPONDENTS

"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

The Editor is not responsible for the opinions of correspondents.

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No communications are answered by post, even though stamped and directed envelope be enclosed.

MUSICAL STONES.

[1942]—The account of Mons. Baudry's Silex Piano in Knowledge of Sept. 4th, recalled to my mind an exhibition to which I was taken when a small child more than forty years ago. The so-called Rock Harmonicon was set up either in Bond-street or in Regent-street by its inventors, a father and his two sons, who were the performers. As far as my recollection serves me, these people were Welsh quarry-men, who accidentally made the discovery that certain stones had musical sounds. The key-board of this instrument (if one may call it such) was more than twice the width of an ordinary grand piano; it had two rows of stones, one above the other, like the white and black keys of the pianoforte; each performer had the command of at least one or two octaves. The effect was most pleasing and sweet; simple airs only were attempted. At this distance of time I cannot say what was the nature of these stones, but they had a greenish colour, and looked as if taken from the quarry, and roughly chipped here and there. It is possible that this might have been done purposely to give the exact tone required.

May I be allowed to differ from the editor of "Cosmos" when he states (as quoted in "La Nature") that the flint was the first arm, the first tool of pre-historic man?

Flint implements were, no doubt, largely used in pre-historic times, but no one can possibly know whether they were the *first* arm or the *first* tool of pre-historic man. Much would depend upon the geological formation on which any particular pre-historic race belonging to the Stone Age lived; they would naturally use any suitable stone which was near to hand; as, for instance, where the chalk formation was present we may reasonably expect to find flint implements in greater numbers than those of any other stone. Flint, too, has this great advantage, that it is comparatively soft and easily worked when first taken out of the chalk, and hardens afterwards. Flint implements would, probably, be better adapted for one kind of work than another; on the whole, they would not seem to be so widely spread as other varieties.

In Brittany, in Denmark, and in Guernsey, celts have been found made of various kinds of stone, viz., of diorite, of fibrolite, of a stone resembling basalt, and even of sandstone. In all three localities celts have been discovered made of a material which is known to exist no nearer to them than Hungary. It has been conjectured that such implements were regarded by their owners as valuable possessions, and transported on the person to the land where we now find them. Cosmopolitan.

INSTRUMENTAL MUSIC.

[1943]—Referring to the remarks of "Kolokol" and yourself in a late number of Knowledge on the subject of instrumental music, perhaps a few hints, founded on practical experience, may be of use. Accepting the limitations of "Kolokol's" conditions and desires, viz., age exceeding twenty-five years, no previous knowledge of the instrument, and a wish to take part in concerted music, I should say that with practice averaging an hour a day for twelve months (and even less) it is quite possible to attain sufficient execution on certain instruments to afford a large amount of satisfaction to oneself, and even of pleasure to other people. The pianoforte and the violin undoubtedly require a large amount of practice, and to be taken up at a somewhat early age, in order to attain the necessary agility of finger, but this agility is not nearly so requisite in the case, say, of the viola or the violoncello for concerted music, or the organ or harmonium for solo playing. I should recommend "Kolokol" to try the violoncello. He may feel discouraged just at first, but in two or three weeks' time he will begin to feel signs of progress, and in less than a year he will be able to play the bass part in Haydn's symphonies, and most of the 'cello part in the trios and some of the quartettes; and if he never gets further than that he will feel amply rewarded for his efforts. I speak from experience, as I was over twenty-five years of age, and busily engaged all day in a solicitor's office when I first took up the 'cello, and in less than six months I was able to join a small orchestral society, and enjoyed greatly our weekly practice of Haydn's and Romberg's symphonies, varied by an occasional easy overture or other lighter piece. I ought to mention, perhaps, that I was previously pretty well acquainted with the bass clef through choral singing, and I could play the harmonium in a humble way, but could never do much with the piano. I have since also learnt the viola, and find that a very gratifying instrument in orchestral music. The alto clef is somewhat of an obstacle at first, but one soon gets used to it. I can strongly recommend either of these instruments to any really musical person who has not much time for practice, and is not ambitious of brilliant solo playing, but who will find plenty of scope and reward in the comparatively simple (though expressive, and often grand), forms and passages of the older classical music.

W. H. E.

THE FLYING OF FISH AND HEAVY BIRDS.

[1944]—Induced by reading recent articles and correspondence in Knowledge, I should like to make known (if it be deemed of sufficient interest for its readers) the result of my observations on the flying of fish and heavy birds. Referring to notes in my diary, made on my first voyage to Chili, in a sailing ship, some ten years ago, I find that I came to the conclusion that the flight of the so-called flying-fish depended much (almost altogether) on the force of the wind. I took much interest in watching them from under the bowsprit of the ship. I noticed that during calms they seldom disported themselves above the surface of the sea, and that to get out of the way of the ship they scuttled off in all directions by a series of short, spasmodic jumps; but that as soon as a stiffish breeze sprang up they flew off in this manner: when going across the wind, the windward shoulder-fin was turned more or less upward, the leeward one downward; when going against the wind the shoulders of the fish were elevated; and when going with the wind their wing-fins were brought to a suitable angle to receive the wind underneath them, so as to get supported by it; the stronger the wind the longer they were enabled to remain in the air. As soon as I took up my residence in the northern part of Chili, I gave attention to the mounting and soaring of the condor and other heavy birds, with the view of applying my fish-flying theory to them and their prolonged soaring flights. I was at first disposed to think it inapplicable, for I saw these birds on the wing soaring about for hours together while a steady calm prevailed around throughout the day. I should mention that in the north part of Chili there are neither clouds in the air nor trees with foliage on the mountain sides to indicate that although near the level of the sea, where I was, a calm may prevail, when aloft in the stratum of air in which the birds floated a strong wind was blowing all the time. As soon as I had leisure to ascend the mountains (Cordilleras) some 4,000 feet or so I found that nearly a constant and strong wind was blowing at that height and above. At the heights frequented by the condor the atmosphere is so attenuated that considerable muscular effort is necessary to enable the bird to mount and sustain himself in the air without the force of the wind acting on the wings placed in suitable opposition to its direction. Indeed I have at times, when on the mountains and within about fifty yards of the bird, distinctly heard the rush of the wind passing the bird when no muscular movement of the wings was visible to account for the sound. The result of my observations goes to show that flying fish do not disport themselves in the air in calms, and as they do not flap their shoulder fins to support themselves, they require wind to sustain their flight, against which their wings are voluntarily placed in suitable apposition to it. And that the condor (and such like birds), whose habitat is on the mountains, where the air is much rarified, is unable to mount without muscular fatigue, and prefers inactivity to hard work until the wind rises, which compensates for the rarity of the atmosphere, when he delights to mount, and soar, and watch his prey from aloft. If, after mounting, he depended upon the reaction of the air alone through his descent by gravitation, he could not possibly sustain his soaring proclivities but for a

short time; but as an auxiliary to the wind, to which he also voluntarily places his wings appositely, it may be utilised as an aid.

Taltal, Chili, July, 1885. EDWARD MADGE.

SHOWER OF SNAILS

[1945]—Allow me to say a few words respecting the "shower of snails" which your correspondent, B. Reynolds, supposes to have fallen in Pembroke Dockyard on the 3rd inst. These snails, which he says "literally covered the ground," have been seen for weeks previous to this date, and have no doubt been there for years. They are of a small species, the largest not exceeding three-eighths of an inch in diameter. The plot of grass from which they crawled (and where they abound) is about twenty yards square. I heard the yarn a few minutes after the rain ceased, and believing such things possible, investigated the matter. It was evident at first sight that the story was false, though hundreds of the workmen yet believe it. As usual, after heavy rains, the snails had issued from their hiding-place. I can assure you thousands were carried away, and thousands yet remain to be seen. S. J. R.

A CHINESE MOTH.

[1946]—I have before me on the table a moth which has just flown in through a hole in the paper windows of a temple on the hills where the foreign residents of Peking are in the habit of passing the summer. His appearance is much the same as that of an ordinary moth. His wings are of a brownish colour, and his whole body, from the head to the tips of the wings, is about two inches in length. He differs, however, from any moth I have yet seen by having a thick bunch of hairs on his tail, or rather the end of his body. These are of a darker brown than the wings, and look very much like a horse's mane after it has been clipped, except that several hairs protrude above the others. The object of this brush is apparently to frighten any enemy which may meditate attack on the moth; for when anything is placed near his head, his whole body at once makes a sharp semicircular movement forwards, bringing the brush a little way beyond his head. He goes through this action several times in rapid succession, but ceases it as soon as the object of dread is withdrawn from before him. While the movement is taking place the rest of the body remains stationary, the raised part coming up between the wings where they meet on the back. The sudden appearance of a good thick brush, whirled rapidly backwards and forwards over the creature's head, would, no doubt, aid considerably in repelling the attack of any small foe.

I should be glad if any of your readers would inform me, through your widespread paper, if this moth is well known, and is found in other parts, or whether I am to look upon him in the light of a rarity, or merely in that of an "accident." E. T. C. W.

Peking, Aug. 2.

TWIN DANDELIONS.

[1947]—I have found, in a field near Lausanne, more than one twin dandelion, as described by "Ignoramus;" also a dandelion with four distinct heads and four stalks, which, growing together, formed one large square one. C. E. P.

FOOT CLOTHING.

[1948] I thoroughly agree with Mr. M. Williams and your own remarks as to the difficulty of getting boots made to properly fit the feet. Unlike the other reformers of ladies' dress, of whom "Cosmopolitan" speaks [1935], I have given a great deal of attention to this matter. I need not now speak of the faults of fashionable high-heeled and narrow-toed boots, for they are apparent to all who have thought on the subject; but the so-called hygienic boots and shoes, and those made to fit even by good makers, are almost all spoiled by the fact that sufficient room is not left in the leather to allow for the breadth and thickness of the feet. I have been so dissatisfied with the boots that I have seen and tried on, even when made by the best makers, that I have arranged with one firm, Messrs. Marshall & Burt, of 444, Oxford-street, W., to produce boots and shoes specially made under my instructions, and I think that by doing this I am taking a step in the right direction; for, if one firm successfully starts an improved kind of boot, others will soon follow its example. I am devoting considerable space to this subject in my book on "The Science of Dress," which will be published immediately. In further reference to the letter of "Cosmopolitan," I may say that a medical friend of mine allowed his children, when young, to run about barefoot in the house, but had beautiful little morocco sandals made for them to wear out of doors. His children are now grown up, and their feet are quite perfect. I shall be greatly obliged if "Cosmopolitan" will send me the sandals like those of the Kashmiris, which he intends having made, as I should like to show them to the firm mentioned above. They may be sent to my address, 14, Tavistock-square, W.C., and I shall be pleased to receive any suggestions with which "Cosmopolitan" may favour me. ADA S. BALLIN.

LETTERS RECEIVED AND SHORT ANSWERS.

P. J. BEVERIDGE. "As near as I can make it out" was "inverted" as a form of expression needing to be separated from the rest of the text, and without the slightest reference to anything in any of your letters. "Quousque Tandem" was the signature of another correspondent: how you could imagine that a remark on the mustiness of Columbus's egg could refer to your particular view (no egg was ever found, I believe, in a mare's nest) I really am unable to conceive. However, it gave you an excuse for trying my *patientiam*, without inquiring how far *I* was responsible for the objectivity of your infinitively accusative charge. As to Darwin's theory and your defence of your objection thereto, you are free to maintain it *ad lib.* It pleases you; and it satisfies me—that I was quite right in remarking that you misunderstood Darwin. Because he did not think it necessary to explain that by small advantages he did not mean infinitely small advantages,—because, in fact, he treated his readers as reasonable beings—you feel free to attribute to him the absurdity of asserting that no matter how small some difference may be it will eventually produce a large difference. Because a giraffe with a neck one inch longer than his fellows had a real advantage in browsing, and, this telling, the necks of giraffes became eventually as long as we see them—therefore, a giraffe with a neck one millionth of an inch longer than its fellows' would have had a better chance of surviving, and millionths of inch may have been added, according to Darwin, till eventually the full gain accrued. Darwin did not draw the line anywhere, because, no doubt, he assumed his readers to have some degree of reasoning power, and to be able to draw it for themselves. As a mere matter of fact, it is obvious that the development of a finite advantage in a finite number of steps (and I suppose you do not imagine the number of generations of any animal from the beginning of its race to the end, or till now, to be infinite) must demonstrably have required finite steps, not the infinitesimal ones you imagine. And now I would ask you what offence either I or the readers of KNOWLEDGE have committed, that my time and their space should be employed defending Darwin's theory against such attacks as you fondly imagine yourself to have made?—COMMENTATOR. You must excuse me if, since your offence in regard to George Eliot, I see your communications with some degree of prejudice.—A HUMBLE ADMIRER OF HERBERT SPENCER. Those essays were printed in America in company with Mr. Frederic Harrison's; but the latter objected (and no wonder when we consider the figure he presented): so Messrs. Appleton, at Mr. Spencer's request, cancelled the volume. I am quite with you about Mr. Spencer's discussion of religion, and hope to show it in these columns soon.—A. J. S. The apology is ample. The "last straw" came long since; the camel's back, indeed, was not and is not broken; but he has given up all idea of carrying the load. Three weekly kicks, and he is rid of it.—J. L. GREEN. Surely that has not happened often. Anyway it will not happen with KNOWLEDGE monthly.—LAW. HARGRAVE. The acting editor will be sorry, I expect; yet tickled too. Upside down with or without care: as Pip and Joe Gargery would say, "Wot larx!" Yet I am myself so interested in the question of flight, that I hope soon to hear from you that your trochoidal system has been successful, and that in their high flight they have led folks—in Sydney—to say "What! *larks?*"—JOHN BULL. Mr. Browning is an optician; the other a seller of optical instruments. I know little of the instruments sold by the latter: but can confidently advise you to trust in the former.—H. O. C. Science recognises an absolute zero of temperature; but it would take more space than can here be given to explain how and why. Thanks for notes on America.—JAS. BURN. The stars may be inhabitable worlds, in the same sense that a white-hot furnace may be. Spiritual existences might there emulate our old friends Shadrach, Meshach, and Abednego. Your theory on the production of heat has *not* a leg to stand upon.—INSPECTOR-GENERAL. Theory rather too wild for us. I should want a better mirror to see the other side of the moon.—S. H. HOLDEN. Declined with thanks; will be retained a week for stamped and directed envelope.—F. COWLEY, NIL DESPERANDUM, C. M. DU CROZ. Have no knowledge on the subject.—J. M. At once too complicated and too inexact.—T. R. CAMPBELL. I noticed that review of "Modern Science and Modern Thought" in the *Times*, and the passage you quote. Of course it may mean those particular rocks which were so deported; but the whole article suggested that

the writer was very ignorant of science, and had but a smattering even of theology.—VICTOR HORSLEY. Very gladly find space for your very interesting and suggestive letter.—R. LEWINS. Emphatically no; there will not be full scope (as you expect and hope) for attacks on religion in the monthly series of KNOWLEDGE. You are careful to show what you think you see bad and mad in all religions; *I* hope to show what there is and has been that is good. You see we differ widely.—J. H. GARFIT. Of course, it was not really a shower of snails.—B. Considering that I have expressed just that view of Mr. Spencer's teaching in my essay on Happiness, I certainly agree with you.—NIGEL. I have not the remotest notion which would be the best way to get the flesh entirely off a mouse. Try making him editor of a new weekly series of KNOWLEDGE.—ARTHUR MEE. It is a phenomenon of diffraction, if I understand your description rightly.—HALLYARDS. 1. I decline to insert your letter opening with the remark that you have not read the letter to which you refer. 2. "Forbearing to think out" a subject is scarcely the way to escape what you call "repression." If you will kindly think out the effect of the near approach of Number Last of Weekly KNOWLEDGE ("For this relief, much thanks!"), you will perceive that with serial matter which *must* be closed; with letters pouring in by the bushel from others, and a number of yours still in hand—I fear this will never be out of hand in the sense of appearing, I have to repress quite a quantity of matter. I certainly don't propose to publish a supplementary number for outstanding letters, of the class which killed Cock Robin. 3. The church idea won't hold; inconsistent with known dynamical laws. 4. Like you, I do not see the use of considering brandy-drinking alone; your long letter on "Comparative Ebriety" considers nothing else, however. — H. O. C. *Who* says comets consist principally of carbon? They *do* try to cool; but the sun warms them up again. What on earth, or in earth, has the earth's opacity, present or past, to do with the question of her possible past or present volcanic energy? No; the cooling down of a comet in no sense or degree explains its non-return.—HERCULES. Dr. Ball was wrong. But, for myself, I do not care two straws how a man calls his stars. There is enough affectation in the world without bringing the poor stars in. Of course with the planets we must be more careful. Fortunately there is only one planet over which one can go wrong (as ninety-nine out of a hundred do,—saying Uranus instead of Ŭrănus); for no one I suppose will speak of Jew Peter.—E. B. V. Our column for queries of that sort long since closed.—QUOSQUE TANDEM. Permit me to explain that my bad writing, causing some one looking up, or partially recalling (imperfectly it would seem) the passage, led to the very remarkable Latinity of my reply to you.

Our Whist Column.

BY "FIVE OF CLUBS."

ON WHIST STRATEGY.*

(Continued from p. 279).

THE third class of cases to be considered is when the suits are unequally divided in length, and victory or safety depends on success in either ruffing from one hand while partner's hand retains defensive trump strength, or in establishing a cross-ruff. A contest of this kind is interesting and instructive. Nearly always we find that the hasty attempt to make tricks by ruffing through the early lead of a singleton or from a suit of two defeats itself. The enemy see their danger early, and by leading trumps put an end to your ruffing tactics. A cross-ruff can scarcely ever be secured by over-hasty leads from short suits. Where there is a fair chance of a cross-ruff, it is quite commonly lost though a singleton lead.

The third and fourth of our doubly-played hands illustrate the play of hands in which the suits are irregularly distributed. In the former four tricks are lost by the lead from a singleton, while by correct play only the odd trick is lost. In the latter, a cross-ruff is on the cards for *A B*, and if they secure it by correct play they win four by cards: but *A* leading over hastily to secure a ruff, the cross-ruff is missed, and *A B* lose two by cards.

It often happens that two suits are equally distributed between the hands, one hand only having more than three cards, while the other two suits are irregularly distributed. Again it often happens that, while the hands of two players, partners or otherwise, are very unevenly distributed, those of the two others are hands of three-card suits and one four-card suit. Success in securing victory or safety often depends on the early recognition of such peculiarities of arrangement.

* From the Author's forthcoming work on "Home Whist."

Nearly always it is well, while you are still in doubt about the arrangements of the hands, to follow the rules, "Force the adverse strong trump hand;" "Force your partner if you are strong in trumps;" "Refrain from pressing him if you are weak;" "Trump a doubtful card (that is, a card in a suit of which your partner may or may not have the best card) if you are weak in trumps, pass it if you are strong." But you must be quick to recognise when occasion arises for the use of even a fairly strong trump hand in ruffing. You may only be able, for instance, by ruffing from four trumps (the only case in which there can be doubt) to force your partner's weak trump hand. Again it occasionally happens that when you are weak in trumps you may only be able by leading trumps to give your partner the power of forcing you by which the only ruff open to you may be made. Thus do we see all rules go by the board when occasion arises,—the strong hand ruffing, the weak hand leading trumps, and so forth.

Towards the close of a hand everything may depend on properly placing the lead. Here familiarity with certain typical positions is desirable.

Suppose you hold the best, third best, and a small card, either in trumps or in a plain-card suit when trumps are out, the second, fourth, and a small card being on your left, and the other players holding no cards in the suit. Then if you lead the best card you make but one trick, if you lead the small card you make two.

Again suppose your partner holds the best and third best trump and a winning card in a plain suit, opponent on your left holding second and fourth best trumps and a losing card in the same plain suit, while you hold two trumps and a losing card in another plain suit. Your partner leads his winning card, or the player on your left leads his losing card (it matters not which): if now you let your partner's card take the trick, he must lead a trump, and one of the other tricks will go to your opponent on the left. But if you trump his winning card, and lead either the other trump or your losing card, both the remaining tricks go to your partner.

Remember that if you hold the best guarded and your partner third best guarded, or *vice versâ*, in a suit of which one of the opponents has the second best guarded, that second best card must make if led up to in the suit, but will fall if the third best is led through it: if it lies on the left of the best, it will only fall if led from.

Be careful in noting where the strength lies in the various suits. By retaining the inferences made early in the game, you can judge which cards to retain and which to discard. It is idle to retain the King-card in a suit which cannot be led again: yet we sometimes see such a card held, and a small card thrown away in another suit of which that small card was an essential protection. To take a very simple illustration, suppose that after trumps are all out the cards arranged as follows, *Z* knowing where the Spades lie and that all the Diamonds are out except his Ace:—

B holds: Spades—9, 5; Hearts—K.

Y holds	*Z* holds
Hearts—Q, Kn, 10.	Spades—8, 2; Diamonds—A.

A holds: Hearts—4, 3, 2.

A leads a Heart, *B* winning with the King; if now *Z* discards his Diamond Ace he must make a trick in Spades; but if he discards the Deuce of Spades both the remaining tricks go to *B*.

A winning card or an extra trump which if retained will compel you to win a trick and then lead from a tenace or up to the enemy's tenace should if possible be got rid of. Suppose for instance the following arrangement (Hearts trumps):—

B's hand: Hearts—4; Spades—Q, 9, 3.

Y's hand:	*Z*'s hand:
Hearts—3;	Hearts—10, 8;
Spades—5;	Spades—7;
Clubs—A, 4.	Clubs—9.

A's hand: Hearts—Kn, 9, 2; Spades—10.

Y leads Club ace, B trumps with the four, *Z* plays Club nine; if now *A* discards the Spade Ten, he must win the next trick, and lead from his tenace, losing one trick in trumps. But if *A* discards the small trump, *B* wins the next trick with the Spade Queen, and *A* makes both the remaining tricks, *Z*'s minor tenace being led through. Observe that a trick is gained in this way, even though *Z* hold the major tenace and *A* the minor. If for instance *Z* holds Queen Ten, instead of Ten Eight, then by discarding the Spade, *A* is obliged to take the next trick and lead up to *Z*'s major tenace, losing both the remaining tricks; but if he discards the trump Two, undertrumping his partner, *B* makes the next trick with the Spade Queen, and leading through *Z*'s major tenace, *A* makes one more trick. If instead of holding the above hand, *A* held Knave and Ten of Hearts and Spade King and Ten, his proper play to the first round would be Spade King, so that *B* would win the next trick with the Spade Queen.

Throwing away thus a winning card is called playing the *Grand Coup*. It is akin in principle to the lead of the losing card from the major tenace guarded (best, third best, and small card).

Our Chess Column.

By Mephisto.

THE SCOTCH GAMBIT.

We herewith give a few examples of our attempt at meeting the attack of 7. Q to Q2 in this Opening. The actual games played have, however, not been sufficiently numerous to enable us to form a definite opinion as to the merits of Black's defence.

ILLUSTRATIVE GAME No. 13.

1. P to K4	P to K4
2. Kt to KB3	Kt to QB3
3. P to Q4	P × P
4. Kt × P	B to B4
5. B to K3	Q to B3
6. P to QB3	KKt to K2
7. Q to Q2	Castles

A very risky move, which, as will be remembered, led to a lost game in the encounter between Blackburne and Gunsberg at Hereford. Black, however, in that game continued with Q to K4. In the present instance, however, Black gives up two Pawns, in the hope of profiting by his superior development. Until we have further thoroughly tested this variation, we should not like to pronounce in its favour.

8. Kt to Kt5	B × B
9. Q × B	P to Q4
10. Kt × BP	R to Kt sq.
11. Kt × P	Kt × Kt
12. P × Kt	B to B4 !
13. Q to B3	

We are of opinion that 13. Q to Q2 would have been a much safer move for Black.

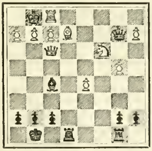
	KR to K sq. (ch)
14. B to K2	Kt to Kt5
15. P × Kt	

If 15. Kt to R3, Kt to Q6 (ch). 16. K to B sq., Kt × P with a good position.

	Q × P
16. Castles	Q × R
17. Kt to B3	to Kt7

and Black won.

White.



Black.

GAME No. 14.

The first ten moves same as in No. 13. In order to avoid the attack consequent upon 11. Kt × P, Kt × Kt. 12. P × Kt, B to B4 or Kt to Kt5. White in another trial played—

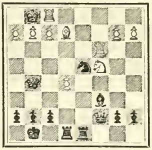
11. Kt to Q2	P to Q5
12. P × P	Kt × P
13. R to B sq.	B to Q2
14. P to K5	Q to QKt3
15. Kt to B4	Q × Kt
16. Q × Kt	Kt to B4

If Black plays P to Kt4 at once, White may play 17. R to Q sq.

17. Q to Q2	QR to B sq.
18. R to B3	KR to K sq.
19. B to K2	B to B3
20. Castles	QR to Q sq.
21. Q to Kt5	Kt to Q5

The game resulted in a draw, as Black won the centre Pawn.

White.



Black.

GAME No. 15.

The first ten moves same as in No. 14. Not being quite satisfied as to the effects of Black's next move, he varied his tactics as follows —

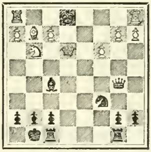
11. Kt to Q2	P × P
12. Kt × P	Q to K4
13. Kt to QKt5	Kt to Q4
14. Q to K2	

There is no other move to avoid P to B4.

	Kt to B5
15. Q to K3	B to B4
16. Kt to Kt3	Kt × P (ch)
17. B × Kt	Q × Kt

and Black won.

White.



Black.

Some highly interesting tries were played in this variation. We hope soon to be able to say whether the attack gained by Black on White playing 10. Kt × BP is sufficient to compensate him for the loss of two Pawns.

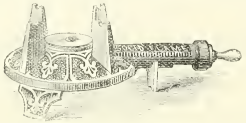
A New Use for Toads. The latest and most ingenious way of getting rid of roaches and water-bugs we have heard of is related of a citizen of Schenectady, whose kitchen was infested with them. A servant, hearing that toads were an antidote, caught three ordinary hop-toads, and put them in the kitchen. Not a roach or water-bug, it is stated, can now be found in the house. The toads have become domesticated, never wander about the house, and are so cleanly and inoffensive that there is no objection to their presence. Another use for toads is to employ them for insect destroyers in the garden. They are determined enemies of all kinds of snails and slugs, which it is well known can in a single night destroy a vast quantity of lettuce, carrots, asparagus, &c. Toads are also kept in vineyards, where they devour during the night millions of insects that escape the pursuit of nocturnal birds, and might commit incalculable havoc on the buds and young shoots of the vine. In Paris toads are an article of merchandise. They are kept in tubs, and sold at the rate of two francs a dozen.—*Scientific American.*

Our Inventors' Column.

*We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (*Knowledge *being a popular magazine) than is accorded by the most excellent trade journals*

HEATING BURNER.

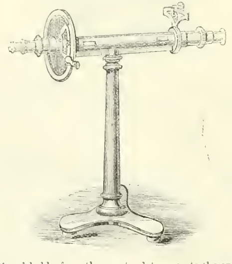
(Patent No 7,121. 1884.)—In this invention, by Mr. S. Siddaway, of 9, George-street, West Bromwich, a plate is fixed just above the frame as shown, leaving a small orifice all round between the two



for the escape of gas to be ignited. Gas is supplied through the jet, air entering through a hole beneath the inlet jet; for large burners more than one gas inlet jet may be used.

POLARIMETER.

[Patent No. 14,699, 1884.] In this instrument, patented by Thomas Bayley, of the firm of Allen & Bayley, 7, West-end Chambers, Broad-street-corner, Birmingham, the novelty is an arrangement whereby all the advantages of a Polarimeter on the principle of Laurent are obtained at less expense. The instrument is essentially a Laurent's, but in place of the half-wave plate of quartz cut parallel to the axis of the crystal, a single thin sheet of mica is employed. The mica is selected by optical methods, and when properly mounted is said to



be indistinguishable from the quartz plate, even to the experienced eye. The half-wave plate of quartz requires great skill on the part of the workman, and is practically unobtainable in England. The accompanying illustration shows a cheap Polariscope on this system; it is graduated with vernier to read to minutes, and has an adjustment to vary the illumination of the field. Another instrument with rackwork adjustments is also made. The advantages of the instrument are decrease of cost, and the fact that monochromatic light is used with direct measurement of the angle of rotation of the analysing prism as in the Laurent instrument.

WASHING CLOTHES.

[Patent No. 10,768. 1884.]—In this invention by Mr. E. Taylor, 43, Canning-street, Bury, Lancashire, a plunger is arranged to force air through the clothes in a wash-tub. A metal tube is connected to a conical part open below; at the bottom of the tube a ball valve is arranged, opening downwards only. When the plunger is forced down among the clothes the included air closes the valve, and is forced through them.

In order to render glue insoluble in water, even hot water, it is only necessary, the *Scientific American* says, when dissolving glue for use, to add a little potassium bichromate to the water and expose the glued part to the light. The proportion of bichromate will vary with circumstances; but for most purposes about one-fiftieth of the amount of glue will suffice.

Mr. R. A. Proctor's Lecture Tour.

Subjects:

1. LIFE OF WORLDS
2. THE SUN
3. THE MOON
4. THE UNIVERSE.
5. COMETS AND METEORS
6. THE STAR DEPTHS
7. VOLCANOES.
8. THE GREAT PYRAMID.

Each Lecture is profusely illustrated.

Communications respecting terms and vacant dates should be addressed to the Manager of the Tour, Mr. JOHN STUART, Royal Concert Hall, St. Leonards-on-Sea.

Oct. 2, Chester; Oct. 3, 17, Malvern; Oct. 6, 9, 12, 13, Plymouth; Oct. 7, 10, 14, 16, Torquay; Oct. 19, 22, 28, Salisbury; Oct. 21, 26, 29, Southampton; Oct. 23, 27, 30, Winchester. Oct. 31, Marlborough College.

Nov. 2, Chester; Nov. 3, 5, 7, Southport; Nov. 4, Burnley; Nov. 9, Stafford; Nov. 10, Streatham; Nov. 12, Middlesbrough; Nov. 17, Darwen; Nov. 19, Saltaire; Nov. 23, Bow and Bromley Institute; Nov. 24, Trowbridge; Nov. 25, 28, Bath; Nov. 26, 30, Clifton.

Dec. 2, 5, Bath; Dec. 4, Clifton; Dec. 7, 8, 9, Croydon; Dec. 11, Chester; Dec. 14, Dorchester; Dec. 15, Weymouth; Dec. 16, 17, 18, 19, Leamington.

Jan. 12, Hull; Jan. 15, Stockton; Jan. 26, Bradford; Jan. 27, Busby (Glasgow).

Feb. 3, Alexandria; Feb. 4, Rothesay; Feb. 5, Chester; Feb. 6, 20, Malvern; Feb. 9, 12, 19, Cheltenham; Feb. 10, Walsall; Feb. 11, Wolverhampton; Feb. 15, Upper Clapton; Feb. 18, 25, London Institution; Feb. 22, Sutton Coldfield.

March 1, 3, 5, Maidstone; March 3 (afternoon) and March 6 (afternoon), Tunbridge Wells.

Contents of No. 204.

NOTICES.

Part XLVI. (August, 1885), now ready, price 1s., post-free, 1s. 3d.

Volume VII., comprising the numbers published from Jan. to June, 1885, now ready, price 9s.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, OCTOBER 9, 1885.

CONTENTS OF No. 206.

THE MYSTERY OF LIFE.*

By the Bishop of London.

[THE Bishop of London said that he desired to take that opportunity of setting forth some traits in the character of a religious physician—an outline, as it were, of that ideal which should ever be before the eyes of a medical student who desired to be really worthy of the noble profession to which he was devoting himself.]

Look at the study, [Bishop Temple proceeded], by which you are to prepare yourselves for the exercise of your future duty. The subject of that study is by far the most complex, the most finished, of all the works of God. Life itself is the most mysterious thing we know in the world of nature. It seems to have no analogue.

In so far as matter is subjected to any kind of either mechanical or chemical action, these may involve almost any degree of change in outer form, but the substance appears to remain the same. As a proof of this, whatever may be done in this way may be undone. What has been compounded may be resolved, what has been resolved may be re-compounded. There is no progress whatever, although there may be infinite variety of combination. There is no increase or possibility of increase of the forces at work. There seems to be no increase or possibility of increase of the material to be worked on. Science assumes, and appears to be justified in assuming, that the original quantity of matter, however it came into being and whatever forms it may have assumed, yet remains exactly what it was, that no particle of it is annihilated and no particle of it is added. Science seems equally justified in assuming that the original quantity of force, however it came into being, passing through every variety of change, sometimes showing itself in heat, sometimes in light, sometimes in electricity, and sometimes in visible motion, nevertheless remains always the same. Thus motion may be converted into heat, but whatever heat is thus produced a corresponding amount of motion must be destroyed.

From this restraint life is free. It exists, it can be communicated, it can be destroyed. But the communication of life by one living form to another by no means involves the destruction of life in that which first possessed it.

And as life stands alone in its power of indefinite increase and diminution, so does it stand alone in the mystery of its origin. The theory of spontaneous generation has been upset in every instance whenever it seemed for a moment to be established.

And while life is thus mysterious in its origin, how wonderful also is it in its development. Nothing else shows itself capable of such progressive ascent from lower forms to higher, from simple to complex, from plain to beautiful, from weak to powerful, from blind to intelligent. Nothing else has in it the same wonderful promise for the future to correspond with all that we know or can reasonably infer from its history in the past. The meanest living creature seems potentially far above the grandest mass of inanimate matter.

And if life, considered in itself, be thus marvellous, how far more marvellous in its most perfect form when, in the human framework, it is the seat and organ of the faculties of sense, of intelligence, of reason and conscience, each in succession rising above the other until we pass beyond the physical to the spiritual nature, and find ourselves contemplating a being whose constitution makes him akin to the Creator of all things, capable of understanding the laws according to which all things have been made, of appreciating the order, the beauty, the sublimity of the universe, of forecasting the aim and purpose to which all things are tending.

This is the subject of the physician's and the surgeon's study, no other can rank higher. With what manly reverence, equally removed from shallow and vulgar coarseness and from silly superstition, will the religious student regard the human body which he studies, and which he daily finds more clearly proved to be the most perfect of all God's works on earth! In his studies he is perpetually on the confines of that mysterious interval, whatever it may be, which separates mind from matter, the spiritual from the physical.

It is impossible for any lengthened investigation, especially if we are examining disease, not to find mind acting very seriously on matter in ways outside what we commonly understand by human action.

And closely akin with this is the near connection of the practice of medicine with the religious life and with the place assigned in that life to prayer. The tendency of science unquestionably is to confine the proper subject of prayer to spiritual things only. And this, not because there is the slightest reason supplied by science for doubting the power of God, but because science leads us more and more to the belief that such interference is exceedingly rare, and, therefore, that frequent interference is not in accordance with the character of God's government. *The reverent and dutiful soul will shrink from asking what there is real reason to believe that it is not His will to do.*

If we pray for our friends in illness, yet there are limits to what we can reverently pray for. We could not pray that a man who had lost an arm should have another in its place. The laws of our physical constitution may be—for purposes of science we rightly assume that they are—similar in character to all other physical laws. But the spiritual comes in so strangely and sometimes so powerfully that we never know what may be

* The opening address of the medical session, delivered by the Bishop of London to the students of King's College Hospital.

the precise working of our drugs, our dieting, our nursing. There is always room for the unseen and unknown and unsearchable. There is no check on the freedom of earnest prayer, however scientific may be the process which the healing art shall prescribe.

The religious student, over and above his sense of the dignity of his subject, will have further the sense that in a very marked degree he approaches to the spiritual world, and to Him who made and rules it. He will realise that he is dealing with what is not physical only, and this will give to all his researches a thoughtful, reverent, self-controlled character which will show itself even in his manner.

The very purpose of the profession is to alleviate human suffering. Sympathy with suffering is the characteristic and the essence of the profession. The physician and the surgeon ought to be—how very often they are—the tenderest, the most merciful, the most sympathising of men.

It is, no doubt, often necessary in the practice of medicine to inflict pain in order to save life, or in order to prevent still greater pain which is seen to be approaching. It may, perhaps, be necessary, in the investigation of medical science, to inflict severe pain on the lower animals while searching into the nature of their bodily powers in order to compare them with our own. But in every case the true physician or surgeon, remembering the supreme purpose for which he lives, will insist on retaining his own tenderness of feeling, will inflict no severe pain that he can by any possibility avoid, will make what pain he inflicts as brief (if it may be so, as instantaneous) as he can possibly make it, will never repeat pain for the mere purpose of the greater certainty of his conclusions, will refuse altogether to inflict pain even for the highest scientific ends if the degree of it be so excessive as to make him feel that nothing would ever induce him to submit to it himself or make him think it just that a stronger being than he should inflict it on him. Nothing can justify him in ceasing to be a man in order to become a more effective scientific instrument of research, nor can the religious investigator surrender that sympathy with all suffering which is his highest title to the respect of himself and fellows.

THOUGHT AND LANGUAGE.

By Ada S. Ballin.

XVIII.

In a former article, treating of the origin of the various signs current among different nations, as expressions of negation and affirmation,* I showed how natural signs had, by abbreviation, become conventional. I have again alluded to it for the purpose of pointing out that the same process which influences the gesture language, is one of the chief causes of change in verbal language at large. All words are more or less traceable to a sensuous origin. Even words apparently so purely symbolic as the pronouns are found to be mutilated forms of conceptual words. Thus the relative pronoun in Chinese was once a substantive meaning *place;* and the Hebrew *asher*, which signifies *as, that,* or *which*, is related to *athar* in Aramaic, which means a *place;* in Assyrian, *asru*. The Assyrian *mala*, *as many as*, is really a substantive meaning *fulness*, connected with the Hebrew *maleh*, *full*. The Ethiopic *lālī* and *cīyā*, which, combined with suffixes, express the nominative and accusative of the personal pronoun, formerly signified *separation* and *entrails*. The Malay *ulun*, *I*, in Lampong still means *a man;* and in Kawi *I* and *a man* are represented by the same word *ngwang*. In Japanese the same word may serve for all three persons, and was originally a substantive meaning *servant*, *worshipper*, or something similar. In Chinese for *I* it is only polite to say *ts'il;* the *thief*, and *mine* and *thine* are respectively *tsián*, *bad*, and *ling*, *noble*. In Greek, *ὅδε ὁ ἀνήρ*, *this man here*, is an equivalent for *I*.

* No. X.

Words from constant use get worn down, like coins, and their original meanings become effaced; they dwindle into mere enclitics—"empty words," as the Chinese call them, and are attached as prefixes or suffixes to other words, the meaning of which they serve to modify. Thus the Hebrew *bêt*, *house*, abbreviated, becomes the prefix *b*, meaning *in*. It is thus that what the ancients called secondary words were derived from the primary.

Although the processes of phonetic decay were not dreamed of until quite modern times, the principle was clearly understood many centuries ago. This is evident from the "Dialogue Cratylus," in which Plato shows a true grasp of the nature of language and mastery of the subject as far as the knowledge of one language—Greek—could enable the philosopher to infer anything about language in general. In this marvellous work three distinct theories of language, which were probably current in the various schools of the time, are set forth. These may be called—1, the Divine; 2, the conventional; and 3, the natural. Thus Cratylus is represented as believing that a superhuman power gave things their first names, which are, therefore, necessarily their true names. On the other hand, Hermogenes maintains that names are given purely by convention and the habits of the users, and in support of this argument instances the fact that in different cities and countries different names are used for the same things. While Socrates holds that language is natural and also conventional, a position in which he is strengthened by all the facts of modern linguistic science.

Just as natural signs by abbreviation and other changes, brought about by carelessness in their performance, may become conventional; so by phonetic change may the origin of words be obscured, and what may be called *natural* words become conventional.

In his interesting commentary on this "Dialogue," Jowett remarks:—"In a sense, Cratylus is right in saying that things have by nature names, for nature is not opposed either to art or law. But vocal imitation, like any other copy, may be imperfectly executed, and in this way an element of chance or convention enters in. There is much which is accidental or exceptional in language. Some words have their original meaning so obscured that they require to be helped out by convention. But, still, the true name is that which has a natural meaning. Thus nature, art, chance, all combine in the formation of language; and the three views respectively propounded by Hermogenes, Socrates, and Cratylus, may be described as the conventional, the artificial or rational, and the natural. And this view of Socrates is the meeting-point of the other two, just as conceptualism is the meeting-point of nominalism and realism."*

The great stumbling-block in the way of the progress of the science of language, as it has been in so many other sciences, is the endeavour to simplify in theory to an extent not warranted by the facts at hand. Thus various schools of philologists have maintained different theories

* "Dialogues of Plato," Vol. I., p. 622-3.

of the origin of language, each accounting for it by one cause and ignoring all other influences. We have had the Onomatopœtic, or imitative theory; the Interjectional, which maintains that language is derived from the imitation of interjections; and, finally, Max Müller's theory that, as everything in Nature produces certain sounds or rings, language has its origin in this. The first two theories have been nicknamed by Max Müller the Bow-wow and Pooh-pooh theories; while, in revenge, Prof. Whitney has called the last the Ding-dong theory. These nicknames perhaps show better than anything else the utter contempt in which each party holds the hypotheses of the others, yet each has a certain amount of right on his side, and all might be reconciled to each other, and from the materials of their own form a theory which would be in accordance with all the facts in our possession if they would only be convinced that, into a great and complicated matter like that under discussion, a variety of elements must necessarily enter. This truth was evidently partially grasped by Plato, and it has been clearly brought out by Jowett, both in the preceding passage and in the succeeding, which I quote as a model of liberal thought and clear exposition of a difficult point. He continues :—

"Neither is Plato wrong in supposing that an element of design and art enters into language. The creative power abating is supplemented by a mechanical process. 'Languages are not made, but grow'—but they are made as well as grow; bursting into life like a plant or flower, they are also capable of being trained, and improved, and engrafted upon one another. The change in them is effected in earlier ages by musical and euphonic improvements; in later ages by the influence of grammar and logic, and by the poetical and literary use of words. They develop rapidly in childhood, and when they are full grown and set, they may still put forth intellectual powers, like the mind in the body; or, rather, we may say, that the nobler use of language only begins when the framework is complete. The savage or primitive man in whom the instinct is the strongest is also the greatest improver of the forms of language. He is the poet or maker of words, as in later ages the dialectician is the definer or distinguisher of them. The latter calls the second world of abstract terms into existence, as the former has created the picture sounds which represent natural objects or processes. Poetry and philosophy—these two are the two great formative principles of language when they have passed their first stage, of which, as of the first invention of the arts in general, we only entertain conjecture. And mythology is a link between them connecting the visible and the invisible, until at length the sensuous exterior falls away, and the severance of the inner and outer world of the idea and the object of sense becomes complete. At a later period logic and grammar, sister arts, preserve and enlarge the decaying instinct of language by rule and method, which they gather from analysis and observation." *

THE ECLIPSED MOON SUNLIT.

By Richard A. Proctor.

FROM letters which have reached me I find that the illumination of the moon during central lunar eclipse is not understood by many, who yet have read the usual explanation as given by Sir John Herschel and by others. What I did a little time ago in the way of supplementing that explanation was found by some to have the effect of making clear to them how imperfect had been their previous knowledge of the matter, and how incorrect had been many of their notions respecting it. I had already recognised that this must be so. For those mistakes and misapprehensions which I had proposed to correct (those, that is to say, which I had noticed in Mr. Mattieu Williams's "Science Notes" in the *Gentleman's Magazine*) showed clearly that the general reader must be apt to misunderstand the usual explanation altogether. I had also noticed mistakes by others who might have been expected not only to follow understandingly the correct (but incomplete) explanation given by Sir John Herschel, but to be capable of interpreting the matter for themselves.

I propose now to consider, not those circumstances which I dealt with before, but the preliminary explanation, which I assumed before to have been to some degree mastered and understood. I deem it a duty to do this, and to do it in these closing numbers of the weekly Knowledge, because many seem to imagine that the matter is in some degree in dispute; whereas the only difficulty there really is in the matter is to make that clear which everyone acquainted with the laws of geometrical and physical optics knows to be true.

Mr. Williams, indeed, considers that he has been entirely misunderstood by me, a supposition natural enough in such cases, where there will generally be misapprehension even on the part of those who have mastered a subject—misapprehension as to the exact way in which the facts have been misunderstood. One is apt to suppose that *this* particular mistake is likely, and *that* mistake impossible, when, as it turns out, it has been the seemingly impossible mistake, not the likely one, which has really been made. For this reason I will not follow the rather confused reasonings by which the mistaken views I set out to correct have been supported. I will not endeavour to ascertain from them precisely how those mistaken views arose. In the advocacy of mistaken views there is necessarily confusion often worse confounded than the original mistake).

I take then the mistaken notion that during total lunar eclipse the moon is lit up only or chiefly by light from our illuminated atmosphere, the ruddy twilight glow in our air,—not by rays which have come from the sun himself, in the same way precisely that rays come to us from the setting sun. That this mistake was originally made by Mr. Williams is obvious in two ways: First it was essential to the theory in hand that this misapprehension should be entertained, and secondly the mistake was directly involved in the deduced estimate of the amount of sunlight falling on the moon during totality. Remove this mistake, and the theory of a self-luminous moon is at once shown to be superfluous,—and (through its superfluity) as impossible as water standing an inch above a goblet's brim.

The mistake evidently had its origin in the idea that when the earth lies between the sun and moon, the atmosphere of the earth plays the part of the outer shell of a spherical lens, bringing the solar rays to foci between the earth and the moon. The idea manifestly was—and and I find the idea is quite commonly entertained—that the moon, being set where she is, at the time of central eclipse, receives rays corresponding only to that particular position of these imagined foci which brings them at or near her surface. The fact that rays from every part of the sun reach the moon if she is beyond her mean distance, and from nearly every part when she is in perigee (rays

* Vol. I., p. 645.

from every part of the sun reach *nearly* the whole of the moon's surface even then), that in point of fact the sun would be absolutely visible, though distorted, from every part of the moon's surface at the time of central total lunar eclipse, is regarded as incredible. Yet it is the simple truth.

This is precisely the fact which I not only took for granted, but which I treated—in my former papers—as a fact which should be obvious to every one likely to be studying this subject at all. The only difficulty I could see—in fact the only difficulty there is, but it is much more troublesome than I imagined — is a difficulty which would quite as much trouble an unsound reasoner in trying to determine whether the sun would be visible through the effects of refraction after he had really set in the geometrical sense. If we did not actually see the sun in this way, I imagine we should find many persons capable of clearly proving that the sun could not be so seen, or only by a very small portion of his light. One of these—misapprehending perhaps an explanation by Sir John Herschel—might reason thus:—

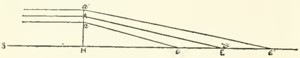


Fig. 1.

Suppose H E to be the plane of the horizon, and put H A to represent the air at H (it is a little wild to represent the air by a straight line, but Herschel, who unfortunately seems to have had little skill in planning diagrams, represents the earth herself by a straight line in the corresponding part of his explanation of the ruddy eclipsed moon) E, the eye of an observer. Then if a ray S A from the sun S below the horizon is refracted in the direction A E, it will reach the observer at E, but only just that ray; for a ray S *a* will be refracted to *e* far on one side of him, and a ray S *a'* will be refracted to *e'* far on the other side of him. Therefore he will get but the merest fraction of the sun's light, and to say that he will actually see the sun, (apart from atmospheric absorption) as well as if the sun were above the horizon is absurd on the face of it. And so forth.

Only, as a matter of fact we see the sun, and so this false reasoning never gets fairly started,—as the corresponding false reasoning about the ruddy eclipsed moon very naturally has been.

Now let us consider the real facts in regard to the moon.

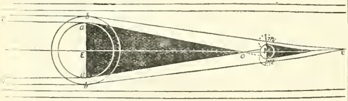


Fig. 2.

Let the lines in Fig. 2 be supposed to represent rays coming from a point on the sun, very far away on the left to the earth E and the moon M at the time of total eclipse. The rays which come through the atmosphere at *a* and *a'*, just touching the earth are bent through an angle of about 34′ as they enter and as much as they pass out, so that they are deflected through an angle of about 68′ in all and cross at a point as *c* which lies on the line E M, not far from the moon M, because the angle *a* M E (or more precisely because the angle whose *sine* is E *a* ÷ E M) is only about 58′, whereas the angle *a c* E is about 68′. Rays which pass higher up, as at *b* and *b'* are deflected less, and cross as at *c'*, on E M produced, farther and farther away till we get no deflection at all and the rays simply radiate on straight lines diverging from the particular point on the sun we are considering. If *b*, *b'*, are at a height of $3\frac{1}{2}$ miles where the atmospheric density is reduced one half, the deflection will be about one half what it is at the sea-level, or the angle *b c'* E about 34°, so that rays travelling so high in our air would pass considerably beyond the moon when she is situated as shown in Fig. 2, supposed to correspond to the time when the particular point on the sun considered is just centrally beyond the earth supposed to be seen from the moon.

So far we have what Sir John Herschel has pointed out, in the passage whose full meaning has been so strangely misunderstood. The moon at M gets but a small proportion of the rays carried around the earth in the way shown. In fact as we know that she subtends about 32′ as seen from the earth, she only gets those rays, of the particular set illustrated above which are deflected within 16′ on either side of 58′,—that is, which are deflected between 42′ and 68′ (none are deflected between 68′ and 74′, the necessary angle to just reach the lower edge of the moon from near *a* and the higher edge from near *a'*.)

If we suppose rays from the middle of the sun's disc (as seen from the earth or moon) dealt with in Fig. 2, it is easy to make the same figure by a slight addition illustrate the case for rays from points on the edge of that disc. For a line from the edge to E (that is, from either point on the edge of the solar disc in the plane of our figure) would be inclined either in direction E *m* or E *m'*, where the angle *m* E *m* (bisected by E M) is the angle subtended by the sun's disc. We shall be near enough to the truth in putting *m* and *m'* on the outline of the moon at M. Then, instead of encumbering our figure and our minds by drawing a complete set of rays for each or for either of these directions, all we need do is to regard the set of rays already drawn as corresponding to either case, and setting a moon at *m* and at *m'* as shown. For either of these moons, the case is illustrated in which the particular point on the sun's surface dealt with lies at the edge of the sun's disc as seen from the earth or moon.

Now in reality this—so far as a general explanation of the illumination of the moon's surface during totality is concerned—ought to be enough. Sir John Herschel was content to give even less in the way of explanation and illustration. Yet he showed clearly enough all that is really essential.

But strangely enough this explanation has been altogether misapprehended. It has been supposed to show that the moon can receive scarcely any light from the sun by the actual deflection of solar rays towards her, insomuch that the light thus received counts for little or nothing compared with such illumination as the moon receives from our terrestrial twilight glow, from the burnishing of the edge of our earth's disc by solar illumination. That from the moon's surface situate as in Fig. 2, the sun himself is actually visible, so distorted and so reduced in apparent size that much less light than usual comes from him, but still that it is his very own self which is seen, as certainly as the setting sun is seen by

us after geometrical sunset is completed,* this, which is really shown by the above explanation, remains with many a matter not only hard to see, but actually to be denied as absurd on the face of things.

The difficulty commonly presents itself in this way. If by the bending power of the earth's air rays from a particular part of the sun's disc are deflected to the moon, then rays from another part of the sun's disc must be deflected away from the moon; how then can all parts of the sun's disc be visible from the moon? Added to which comes another difficulty, based on a different misapprehension,—If light from every part of the sun reached the moon she would not be in eclipse at all, but shine as brightly as ever.

Let us see how the matter really is:—

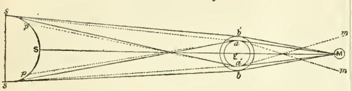


Fig. 3.

Suppose first that *s a* is a ray from the lowest point *s* of the sun S (lowest considered with reference to the figure) to the earth's atmosphere at *a* and so deflected as to pass to the moon at M. Then it is obvious that a ray *s′a* from the highest point *s′*, will be carried as to *m*, and not reach the moon at all. *But* a ray from *s′* to some point *b′* in the atmosphere above *a*, will be deflected precisely to M. Thus an eye placed at M would see the part *s′* of the sun in the direction M *b′*, and the part *s* in the direction M *a*, and all intermediate points on the face *s* S *s′* in directions intermediate to M *a* and M *b*. Thus the diameter of the sun's disc from *s* to *s′* (the semicircle *s* S *s′* in reality would be transformed into a short straight line *a b′* on the edge of the earth's disc as seen from M. In like manner the same diameter of the sun's disc would also be transformed into a short straight line *a′b* on the opposite edge of the earth's disc, by rays following courses ranging from *s′ a′* M to *s b* M. Imagining the plane of the figure to revolve on the straight line S E M, we get the same result for every diameter of the sun's disc,—or the sun transformed into a ring around the earth, in the manner already dealt with (all but these preliminary and I had supposed nearly obvious considerations).

Here we have supposed the moon in apogee. If she is nearer the earth the point *s* on the sun will not be rendered visible by refraction at *a*, which would carry it above the moon. A ray from some point *p*, near to *s* would be so carried, and the arc *p* S *s′* would be visible at *a* transformed into a straight line as *a b′*, while a corresponding arc *p′* S *s* would be visible at *a′* transformed into a straight line as *a′ b*. The whole sun would be visible, but not *every* part of the sun *doubly* visible as in the former case.

These rays thus falling on the moon are rays of actual sunlight, not different from the rays by which we see the setting sun except in having some of them traversed a greater range of terrestrial atmosphere, and so having suffered more absorption, and making the ring into which the sun is transformed or distorted look, at least along its inner edge, much ruddier than our setting sun usually looks. I say "some of them," because clearly the rays which like *s′ b′ M* have only traversed the higher regions of our air would not suffer absorption in anything like the same degree.

And here, in passing, let me remark that Mr. Ranyard's idea that the parts of our air above the highest range of clouds may be (or as he suggested *must* be) the parts chiefly acting in carrying sunlight to the moon during total eclipse, is inadmissible. The refractive power of air is nearly proportional to its density. At a height of $3\frac{1}{4}$ miles the air will not deflect the sun's rays more than 34′, as already mentioned, and in central total eclipse this would not suffice to bring a ray of sunlight to the moon. For, as supposed to be geometrically measured from the moon (one cannot say "seen" because it would be hidden), the edge of the sun's disc at the time of central eclipse would be more than 40′ from the edge of the earth's disc. Probably the highest part of the air effective at that time in bringing the sun into view would be not more than two and a half miles above the sea-level, and it could not be more than three miles. Clouds float much higher than that. If further proof were needed, it would be found in the ruddy colour of the eclipsed moon, which shows that usually the light she then receives has traversed the lower strata of our air.

This in reality is a sufficient solution of the problem of the ruddy-eclipsed moon. At least the solution is sufficient when combined with such an inquiry into the amount of illumination which the moon would receive, as I gave in former papers. What else I then wrote was chiefly an elaboration of the necessary part of the explanation, by an investigation of the actual nature of the distortions of detail which the sun's face would undergo.

(*To be concluded in our next.*)

* Geometrical sunset is completed when the sun's globe has passed below the plane of the natural horizon.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from p.* 270.)

So far we have only spoken of light and darkness as the results of polarisation. It remains briefly to touch upon the gorgeous chromatic phenomena exhibited when light thus altered in its character traverses certain minerals and organic substances. We will, first of all, say something of the phenomena themselves, and then endeavour to afford, very shortly indeed, as much of an explanation of their cause as can be given without the employment of mathematics. The mineral known as Selenite will supply us with material for the experiments we are about to make. It is the crystalline form of gypsum (from which Plaster of Paris is made by burning it). Crystals of it are very common in the London clay of the Isle of Sheppey, whence we ourselves have obtained numerous specimens. Very well, then: obtaining one of these crystals we shall find that it is of a slab-like form, and is made up of innumerable thin plates, which may be split off with a sharp penknife. Let us remove as thin a slice as we can of this. Now, suppose that the rhombs in Fig. 47, the tourmaline plates in Fig. 48, or the mirrors in Fig. 49 (see *ante*, p. 197), are so placed that the image of the original source of light is extinguished, let us place our film of selenite between the polarizer and the analyser (in Fig. 49 A, it would be put through the slit S, square to the axis of the tin cylinder), and upon now looking through the second rhomb or slice of tourmaline, or

into our little mirror, C, we shall see the field lighted with the most lovely colours. We have said colours, because the chances are considerably against the beginner splitting off a film of identical thickness in all its parts from the selenite. Should he succeed in obtaining one of the same thickness throughout, then will the colouring of the field of view be homogeneous. In the first case, he will get patches of the most vivid and gorgeous yellow, blue, red, and green, &c.,—in the latter one of such colours alone. Now let us turn our analyser slowly round through 45°, and we shall find the colours, or colour, gradually fade until the light will pass through the film seemingly unaltered. Proceeding now to rotate the analyser through another 45°, the colours will begin to reappear, *but they will be complementary to the original ones;* that is to say, if the plate transmitted green light in the first position of the analyser, it will now let red light through. If it appeared blue originally, it will now seem yellow, and so on; the colours thus exhibited always being those which, mixed together, form ordinary white light. As the rotation is continued, the changes described will recur (of course, in reversed order) until the analyser has been turned 360° round the ray of light as an axis. Mica, if sufficiently thin, will exhibit similar phenomena, as will thin slices of quill or horn, tartaric acid crystallised on a plate of glass, the frost ferns on the window-panes in winter, and numerous other substances. Let us, in conclusion, see whether we cannot obtain some general idea of the manner in which these most striking and beautiful appearances are produced.

If we remove the analyser, and look at the beam of light proceeding from the polarizer through our film of selenite or other material alone, we shall see such light absolutely uncoloured. Hence it is obvions that the analysis of this whole light, or its separation into colours, is effected by the analyser. Now, selenite is a doubly refracting crystal, and when the polarised ray enters it, it is resolved into two rays, vibrating at right angles to each other. These rays are differently bent; and bending in a refracting medium means going more slowly, the ray which is the more bent being the tardier of the two. From this it will be readily seen that one of these rays may get half a wave-length, or any odd number of half-wave lengths, ahead of the other (Vol. VII., p. 321), and that, as formerly explained (*loc. cit.*), they may *interfere*. A little further consideration, though, will show that while these rays are composed of vibrations occurring at right angles to each other, it is physically impossible that interference can occur. But the analyser twists the two planes of vibration into coincidence, so that the waves can now destroy each other. Selenite, or any other doubly-refracting material, has, of course, a sensible thickness, and we have seen formerly (Vol. VII., p. 541) that waves of red light are much longer than those of blue. Consequently we shall require a thicker plate of selenite to retard the red rays sufficiently to extinguish them than we shall if we want to blot out the blue rays. Hence, when these longer waves have been neutralised by interference, the plate of selenite will shine with the colours produced by the shorter ones. *Vice-versâ*, when the shorter waves have been annihilated, the louger waves will get through the analyser, and the colour of the field be derived from the less refrangible end of the spectrum.

Into the exquisite phenomena of circular and elliptical polarisation, it is impossible to enter here. An account of these must be sought in works specially devoted to the subject. All we have essayed to do is to introduce the student to the practice of some remarkable experiments which may be performed at little or no cost; and which serve to admit us to a nearer view of the intimate nature of Light.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

HYMENOPTERA.

(*Continued from page* 264).

THE ants referred to in our last paper are genuine household insects, spending the whole of their lives in the shelter of our abodes, breeding amongst us, and bringing up their extensive families year after year in the same spot, as long as provisions are plentiful in the immediate neighbourhood. But this is not the case with the wasps, the next section of the Hymenoptera which will engage our attention. It is true that occasionally their nests are found in outhouses or lofts, or under the eaves of thatched roofs; but this is exceptional, and, as a rule, they enter our houses only in their adult condition; still, they are then such tiresome pests—at least, in imagination, if not always in reality—that we cannot forbear to grant them a place amongst our household insects.

Notwithstanding the popular prejudice against wasps, there are many points of interest in connection with them. Their economy is remarkable, and inferior in interest only to that of bees and ants; their courage is certainly extraordinary; and though they are frequently an annoyance to us through their intrusive habits, yet there are, as we shall presently see, some counterbalancing advantages following from their mode of life; and, finally, their character is not really quite so black as it has been painted. That they are not, as some people seem to suppose, actuated by an irreconcilable hostility to human kind has been sufficiently demonstrated by observers who, like Sir John Lubbock, have closely studied their habits, and have fonnd it possible to tame them and make pets of them, and to induce even such fiery-tempered beings calmly to feed out of their hands and to crawl over their persons without bringing their murderous weapons into requisition. Indeed, one observer, Dr. Ormerod, expressed his opinion that they are much less fickle and more reliable than bees—an opinion, however, which will probably not be generally endorsed.

They will rarely attack unless provoked, and, though it is not easy to maintain a philosophic composure and indifference when a wasp is buzzing round one's head, yet such would no doubt be the best policy; at any rate, the violent flourishes and dashes so often made against them with handkerchiefs, knives, or what not are more likely to irritate than to drive away insects so renowned for valour. Of course, when we attack their citadel, they will at once assume the offensive (as who would not?), and fight to the death for house and home. Very hot or windy weather, too, seems to bring out whatever spitefulness they possess, but this also is a psychological experience not altogether foreign even to *Homo sapiens* himself!

In distinguishing wasps from other Hymenoptera no reliance must be placed on the mere presence of yellow bands on the body, for though all wasps, of whatever habits, have these, such a style of ornamentation is by no means confined to them, but is of frequent occurrence throughout the whole order. But there is a certain peculiarity of the wings that will at once separate a wasp

from the crowds of other yellow-banded insects. All wasps have four wings, and this will serve to distinguish them from certain two-winged flies of the order Diptera, with which they are sometimes confounded, but will not distinguish them from other Hymenoptera, as four is the natural number of wings in this group. But the anterior wings are folded longitudinally in repose, *i.e.*, when a wasp closes its wings it not merely lays them along its back, as a bee would do, but also folds each fore-wing along a line running from its attachment to the thorax to the middle of the outermost or rounded edge of the wing (Fig. 1), the lower and more flexible part being bent

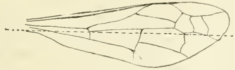


Fig. 1.—Wing of Wasp, showing line of folding.

under the rest, so that the wing becomes only half as broad as before.

In consequence of this peculiarity, the name Diploptera, or "doubled-wings," is given to that section of the order which contains all the wasps, and by this peculiarity they may at once be distinguished from all other Hymenoptera. One would naturally suppose that there must be some connection between this curious habit and the economy of the insects—something to account for so strange a departure from the general practice of the order; but if there be, it has yet to be discovered.

Our British wasps are of two totally distinct kinds. Those that usually obtrude themselves upon our notice are the *social* wasps, of the family *Vespidæ*, and, like the ants and other social insects, they exhibit the peculiarities of the three so-called sexes, the common abode, and the common labour for the common welfare. But besides these there are the *solitary* wasps, of the family *Eumenidæ*, which, from their habits of burrowing in sandy banks, are often called Sand Wasps and Mason Wasps. These have but two sexes, do not form large communities, and, after having provisioned their nest with food sufficient to last the whole lifetime of the larvæ, leave their young to take care of themselves. They are less robust than the *Vespidæ*, and though still yellow-banded, have a much larger proportion of black about their bodies.

It is only very occasionally that we find solitary wasps in our houses; their young feed upon small caterpillars and other insects, and the chief business of the parents' life is to provide a stock of these, so that they have not the temptation to intrude on our privacy which the *Vespidæ* have, for the latter are almost omnivorous, and there are plenty of things in our houses which suit their taste admirably. The solitary wasps of the genus *Odynerus* do, however, sometimes construct their small nests in the most outlandish places. The nests consist of separate cells, each closed in and complete in itself, and devoted to the use of a single grub. Each contains an egg and a store of little caterpillars, each stung by the mother wasp sufficiently to prevent it from being at all lively, but not sufficiently to cause it to die and shrivel up.

These little clusters of cells have been found, amongst other strange places, inside the lock of a kitchen-door, where, notwithstanding the noise and disturbance caused by the passing and repassing of persons continually going in and out of the kitchen, the mother built cells for her brood, provisioned them, and sealed them up, and the young went through all their metamorphoses successfully, appearing in the kitchen when they had assumed the perfect form, to the no small surprise of its inmates.

In the keyhole of an eight-day clock-case, too, one family was brought up, appearing to be in no way disturbed by the ticking or periodical winding-up of the clock. They have also been found in the drawer of an old-fashioned looking-glass, in the folds of a piece of paper that had fallen behind some books, in hollow reeds used as thatch, and in the barrels of a pistol that was hanging invitingly on a post. In all these cases, accident furnished the insects with cavities ready made, and saved them the trouble of excavating their own burrows. These wasps are also sometimes seen in windows, buzzing about, apparently endeavouring to discover why a medium so transparent as glass should yet be able so successfully to bar their exit into the outer world.

The abdomen of an *Odynerus* is of a very curious shape. In all the wasps, the first segment seems more or less like a cap on the succeeding ones, but this is much more markedly the case in the solitary than in the social species. In the genus *Odynerus* the abdomen bears a ludicrous resemblance to a peg-top surmounted by a polo cap which is rather too small for it (Fig. 2). The second segment is of enormous size compared with the succeeding ones, and being very convex above, forms the head of the top. This segment is black, except the hind border, which is yellow, and the succeeding segments are more or less deeply margined with the same colour. The basal segment, *i.e.*, the cap, is also furnished with a yellow marginal band, the shape of which is an important aid in the identification of the species. The folded wings and the top-shaped abdomen are quite sufficient to enable any one to recognise a sand-wasp.

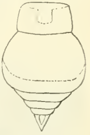


Fig. 2.—Abdomen of Odynerus.

The *Vespidæ*, or social wasps, which are much more frequently seen in our houses, we must reserve for the next paper.

(To be continued.)

THE YOUNG ELECTRICIAN.

By W. Slingo.

(Continued from p. 249).

Ex. CIX.—Before leaving the question of electroscopes there are one or two points that it will not do to overlook. Nothing was said in the previous article about a base for the instrument described, nor is it essential to have one, as it can be simply stood on the table, or any other dry substance. However, there is

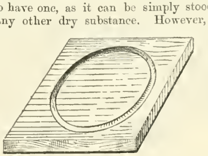


Fig. 64.

some danger of damaging the leaves when carrying the instrument from place to place if there is nothing to exclude currents of air. Fig. 64 gives a general idea of a

base that will prove as useful as any. It consists simply of a piece of board, say three-quarters of an inch thick and one to two inches larger than the instrument. The board may be square or round, and in it cut, or have cut by some friend in possession of a lathe, a circular groove a quarter of an inch deep and about the same width. The groove should be of such a diameter that the glass may stand in it without touching either side of it. Having placed the glass in position, pour into the groove some liquefied paraffin wax until the level of the board is reached. This is simply to lightly cement the wood and glass together to permit of the instrument being carried about, and to exclude moisture, &c. Feet may be provided by

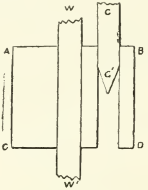


Fig. 65.

screwing pieces of wood of equal thickness on to the under side of the piece of board. The thickness need only be sufficient to allow the fingers to pass underneath the base for lifting purposes.

For my own part I rarely use a base, but, before commencing to work my electroscope, lay it carefully on its side before the fire, to dry the glass and expel as much of the moist air as possible. Something of the kind should be done before fixing the glass on to the base, or the instrument is likely to prove of little use on account of the confined moisture.

Ex. CX.—Another plan, which I have frequently and satisfactorily resorted to, is to provide the stopper (D, Fig. 61) with two holes, as shown in section in Fig. 65, where A B C D is the stopper and W W′ the brass rod or wire. The second hole is bored parallel to it and of such a width, say a quarter of an inch, as to allow a piece of glass tubing, G G′, to fit tightly. The tubing, it will be seen, is sealed at one end. The object is to enable one to drive out the damp air by gently warming the instrument when in the ordinary vertical position, the piece of tubing being withdrawn to permit the escape. When the warming is finished the tubing may be restored, and a further supply of moist air, which would otherwise find its way in, excluded. Where the cemented base is used the piece of tubing may be also cemented in (after the drying operation) by means of shellac varnish, &c., as it will rarely require to be withdrawn.

Ex. CXI.—To seal up the end of a piece of glass-tubing is a matter of little difficulty. All that is necessary is to hold a piece of ordinary glass-tubing over a gas

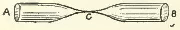


Fig. 66.

or spirit flame, placing one hand at A (Fig. 66) and the other at B, and revolving the glass gently in the flame, which we will suppose to be at or under C. When the flame turns decidedly yellow in colour, the glass may be regarded as having been more or less softened. It should then be withdrawn from the flame and pulled apart with both hands. The diamater of the tube will in consequence be diminished, and may be made as small as we wish. As we at present only require a short, taper point, the pulling should be done as quickly as possible. If it were required to produce a long taper or a very fine hair-like tube, the pulling should be gradual, but equably maintained. A great deal depends upon the shape of the flame employed. When a short taper is required, only a narrow flame, such as that from a small spirit-lamp, should be used. But for most purposes, such as bending, long tapers, &c., a good batswing gas flame answers as well as anything, the glass being placed in the plane of the flame, that is, so that the greatest possible length of glass is heated. The reasons for this are too apparent to need detailing. It should be borne in mind that the glass should be thoroughly dried before being placed in the flame, as the smallest drop of water falling on the heated part is sufficient to fracture it. The glass should also be *kept revolving* during the whole of the time it is over the flame, or it will be unequably heated, and will, therefore, only extend badly, possibly it will break.

Condensing Electroscopes.

Ex. CXII. Fig. 67 illustrates a useful addition which may be applied to our electroscope. It is known as a "condensing" plate, and consists primarily of a piece of sheet metal provided with an insulating handle, and having its under face coated more or less perfectly with an insulating material. The plate AB may be of tinned

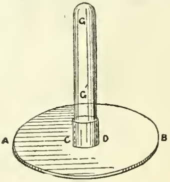


Fig. 67.

iron or any other metal, but brass looks best and costs but very little. It should be of the same size as the plate or cover of the electroscope (A, Fig. 61), and may be of the same thickness. In the centre of it a small piece of half-inch brass tubing C D should be soldered (Ex. XI. to XIV). The length of the tubing need not be more than half an inch. Then procure a piece of glass tubing, G G′, five or six inches long, and about three-eighths of an inch in diameter; the end G of the glass should be sealed by revolving it in a good strong flame, holding it in a slightly inclined position, so that the glass will have a tendency to run down. If need be, the sealing may be assisted by using a piece of glass in the other hand and working the end G therewith. When the sealing operation is completed the end G′ of the tubing should be placed in the soldered cup C D and cemented in with a little plaster of Paris. When the latter is dry the handle G G′ should be coated with a layer of shellac varnish, whereby a good insulating handle is insured. If the sealing cannot be accomplished by

fusing the glass, the tube may be plugged with a small piece of dry wood or with a little plaster of Paris, and then well coated with shellac; or, instead of either of these, a stout test-tube may be employed, inverting it and cementing the open end. It only remains now to coat the under surface of A B with shellac varnish and the apparatus is complete. With it many interesting and instructive experiments can be performed.

Ex. CXIII. A more elaborate, but in some cases more useful form of condensing electroscope is illustrated in Fig. 68, where CDEF is a wooden base about three-quarters of an inch thick, six inches wide, and fifteen or eighteen inches long. L is our electroscope (Fig. 61), W W′, the wire bent so that the plate A becomes vertical instead of horizontal. B is the condensing plate illustrated in Fig. 67, a piece of quarter inch glass *rod* being used instead of the piece of tubing G G. The rod is bent similarly to W, and the lower end fastened by plaster of Paris into a foot made by soldering a piece of brass tubing on to a piece of brass, K, which slides over the two strips of brass HH and LL, screwed along the middle of the base, the strips being half an inch wide and long enough to reach from within an inch or so of the electroscope to the opposite end FD of the base; they need not be more than a sixteenth of an inch thick; they should be a quarter of an inch apart; but before being

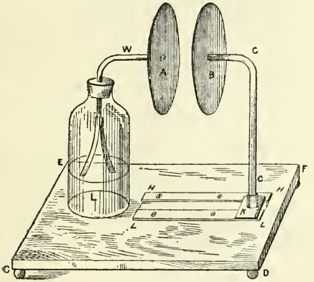


Fig. 68.

fixed, the wood separating them should be cut out with a chisel and saw, a slot being thereby made a quarter of an inch wide and equal in length to the brass strips. Similar strips should also be screwed on to the corresponding portion of the under side of the base. The foot-piece, K, has to support B and the glass rod, and must also offer facilities for changing the distance between the plate A and B. To do this satisfactorily, K should present a vertical section, as shown in Fig. 69. This may be easily made. Cut two pieces of sheet brass, an eighth of an inch thick and measuring three-quarters of an inch wide by an inch long. These form the upper and lower pieces, A B and D C, which slide over H H, L L, and the corresponding underneath pieces respectively. C is a piece of brass a quarter of an inch thick, an inch long, and seven-eighths of an inch wide, the width being just a trifle in excess of the distance between the upper surfaces of the strips H H L L, and the lower surfaces of the strips beneath. A B and D E, being screwed or soldered on to C, a very efficient foot, K, is at once provided and the movable plate, B, can be easily placed at any distance from A, within the range of the instrument. The foot might also be made from a solid piece of brass, filing out the necessary portions. When it is desired to connect B to earth, the back surface may be touched with the finger, or a piece of loose chain (Ex. VIII.) may be passed round the piece of brass tubing into which the upper end of G is cemented. It would be as well to coat G G with shellac varnish.

Ex. CXIV. A makeshift which I have occasionally resorted to with advantage when hard up for an electroscope, and when the necessary materials are not to hand,

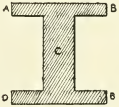


Fig. 69.

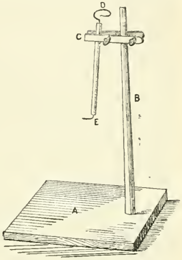


Fig. 70.

is illustrated in Fig. 70. An ordinary wooden retort stand is used, or (as is here shown) a wooden base A is provided with a wooden rod B; two pieces of wood are screwed together on opposite sides of the rod, so as to clamp it securely, and at the same time to hold in position at C a piece of well-insulated (gutta-percha covered) wire D E bared at the extremities, the upper end D being bent in to a loop so as to prevent the extremity acting as a point and discharging any electricity produced in the instrument. The lower end E is bent at right angles, the extreme point being turned back, and a gold or Dutch-metal leaf hung over the wire so that the two pendant parts are of equal length. Any open-mouthed jar, such as the receiver of an air-pump, a pickle-bottle, &c., placed on the base and the leaves suspended within it completes the apparatus, which for temporary purposes will do all that can be fairly expected of it.

There are very many interesting and instructive experiments which may be performed with the electroscope: some of them I have already dealt with; those pertaining to the condensing form of the apparatus should, in a measure, suggest themselves. In the main, they turn on the question of induction, and it is to be hoped that with the apparatus so far constructed, the Young Electrician will pass many a pleasant hour during the fast-approaching winter.

The destruction of Flood Rock, near Hell Gate, the preparations for which were detailed in a recent issue of Knowledge, was to have been effected yesterday, but, owing, it is said, to slight imperfections in the insulation of wires, used to complete the electrical firing circuit, the explosion has been postponed until Saturday.

MYSTERIES AND MORALITIES.

By Edward Clodd.

CONCLUSION.

THE introduction of Moralities dates from the reign of Henry VI., that is, about the middle of the fifteenth century. The personification of abstract qualities which had already found its way into the Mysteries* was a necessary element as the religious plays became less historical and more didactic in character, and the popularity of Moralities obviously quickened, because they were admirable vehicles for attacks upon or defence of current beliefs and superstitions, and could readily concern themselves with the social, political, and religious questions of the time, expressing through their allegorical character the thoughts of men's minds upon these topics.

The earliest extant English Moralities are in manuscript, and of these Mr. Payne Collier gives interesting abstracts in his "History of Dramatic Poetry."† whilst Mr. Carew Hazlitt, in the additions which he has made to the re-issue of Dodsley's "Old Plays," has supplied us with several valuable specimens. The moral play with which that edition opens is not so early as was once held, but is especially interesting, as setting forth the advantage of the pursuit of natural knowledge. It is entitled, "A New Interlude and a Mery of the Nature of the Four Elements (*i.e.*, the earth, the water, the air, and fire), and is assigned to the early part of the sixteenth century. The "Messenger," a name usually given to the prologue, is followed by Natura Naturata, who discourses, it must be admitted very tediously, to Humanity, upon the ethereal region of the heavens and the lower region of the earth, and counsels him to study these. Humanity is, however, beguiled by Sensual Appetite, but, at the last, accepts Nature's reproof. The only known copy of the play is imperfect, the middle and concluding leaves being lost.

Of a still earlier date, although printed in 1522, is the "Propre Newe Interlude of the Worlde and the Chylde," in which the several stages of human life are represented, Man appearing successively as Infans, Wanton, Lust and Lykynge, Manhode and Age. Perseverance recites to him the "Twelve Articles of the Faith" and "The Commandments Ten," when Age signifies his adhesion, and is therenpon named Repentance.‡

In the more important "Morall-playe of Everyman," we meet with some admirable moral teaching in association with expositions of the Roman Catholic religion, the defence of which appears to have been one of the objects of the play. Everyman is the representative of the human race, and is summoned by Death, already personified in the Coventry plays as the messenger of God, to appear before the Divine tribunal, and bring his "book of counte," for

"a reckoning he will need have
Without any lenger respite."

In his fear, Everyman asks his friends—Fellowship, Kindred, Goods, Strength, Beauty, and others—to accompany him; but they one by one forsake him when they learn who has summoned him; and in his despair he betakes himself to Good Deeds, "who is so weak that she cannot stand, verily." She upbraids him for neglect, but leads him to her sister Knowledge, who takes him to the holy man Confession. Everyman then does penance, receives the sacrament, and, with comforting words from Good Deeds, expires. Whereupon the Doctor who has attended him steps forward and delivers the moral:—

Ye herers, take it a worthe olde and yonge
And forsake Pryde, for he deceyves you in the ende,
And remembre Beaute, v. wyttes, Strength, and Discrecion,
They all at last do Everyman forsake,
Save his Good Dedes; there do he take;
But beware, for, and they be small,
Before God he hathe no helpe at all.*

An Act was passed in the reign of Henry VIII., forbidding any person to "play in interludes, sing or rhyme any matter contrary to the doctrine of the Church of Rome." This was repealed under Edward VI., and accordingly among the Moral Plays of his time we have, in "Lusty Juventus," a defence of the Bible against tradition and the superstitions of the Romish Church. The "parsonages that speake" are "Messenger, Lusty Juventus, Good Counsaill, Knowledge, Sathan the devyll, his son Hypocrisie, Felowship, Abhominable Lyvying, and God's Mercifull Promises." Lusty Juventus represents the "frailtie of youth," of "natnre prone to vyce," and is led astray by a gay woman, Abhominable Lyvyng, but finally reclaimed by good Counsaill. The edifying speeches of Good Counsaill and Knowledge are fortified with Bible references by no means contributory to the rhythm, as thus:—

The prophet David saith, that the man is blessed
Which doth exercise himsel in the law of the Lord,
And doth not follow the way of the wicked;
As the first psalm doth plainly record;
The fourscore and thirteenth psalm thereunto doth accord.

My meaning is, as Christ saith in the sixth chapter of Matthew,
To do to him as you would be done to.
I will show you what Saint Paul doth declare
In his Epistle to the Hebrews and the tenth chapter.†

Satan is wittily represented as lamenting the downfall of the old religion: "ful well," he says,

I know the cause,
That my estimacion doth thus decay;
The olde people would beleve stil in my lawes,
But the yonger sort leade them a contrary way.
They wyll not beleve, they playnly say,
In old traditions and made by men,
But they wyll lyve as the Scripture teacheth them.

Hypocrisie recites a long list of the mummeries by which he had deceived men "since the world began":

Holy cardinals, holy popes,
Holy vestments, holy copes,
Holy pardons, holy beads,
Holy saints, holy images,
With holy, holy blood.
Holy stocks, holy stones,
Holy clouts, holy bones,
Holy wax, holy lead,
Holy water, holy bread,
Holy brooches, holy rings,
Holy kneeling, holy censings,
And a hundred trim-trams mo.‡

But such contempt was not confined to the Protestants. In John Heywood's "Enterlude of the Four P's," *i.e.*, a Palmer, a Pardoner, a 'Poticary, and a Pedlar, the author, although a staunch Catholic, flings some coarse satire against the relic-mongers. The play itself is amusing as hinging on a dispute between the four characters as to who could tell the biggest lie. The credit falls to the Palmer, who remarks incidentally that he never saw a woman out of patience, whereupon the others, taken off their guard, declare it to be the greatest lie they ever heard. It is through the Pardoner that Heywood directs

* Vide Knowledge, p. 219, Sept. 11, 1885.
† Vol. II., pp. 200—216.
‡ Dodsley, vol. i., p. 273.

* Collier, II., 228.
† Dodsley, Vol. I., pp. 55, 59.
‡ Dodsley, Vol. II., pp. 65-6.

his attack on the religious frauds of the mendicant friars. He represents him as exhibiting wine drunk at the wedding of Adam and Eve; "a box full of humble bees that stung Eve as she sat on her knees tasting the fruit to her forbidden;" a slipper of one of the Seven Sleepers; the jaw-bone of All Saints; a buttock-bone of the Holy Ghost; and "the great toe of the Trinity," on which the 'Poticary remarks:—

> I pray you turn that relic about:
> Either the Trinity had the gout,
> Or else, because it is three toes in one,
> God made it as much as three toes alone.*

Mr. Herbert Spencer, in his *Study of Sociology*, refers to an illuminated missal in the possession of Mr. Huth, in which the Trinity is represented by three persons standing in one pair of boots. Heywood's satire is justified by the disclosures made in his time in the report of the Commissioners appointed by Thomas Cromwell to inquire into the state of the monasteries,† and by the currency of legends such as that gravely related of St. Clara de Monte Falconis:—

> That after her death there was found in her gall a plain testimony of the Holy Trinity, consisting of three balls of equal figure, colour, and size, and of equal weight, one weighing the weight of two and also of three, yet all three weighing no more than one!

But we pass beyond the assigned limits of our subject in referring to the Interludes, so called because they were played in the intervals of banquets and other festivities, since these fill the gap between the Moral-play and the regular drama. The abstract characters of the former were slowly displaced by concrete figures from history, the portrayal of whose actions came so much nearer men's "business and bosoms" in those stirring times than any life of prophet, warrior, or king of a remote past and unsubstantial age, however crowded with supernatural detail. In addition to this, the institution fell into disrepute by reason of the indecency and buffoonery which were no longer in harmony with the improving taste of the people. So the religious drama passed from the hands of the guilds to those of the strolling player in town and country fairs, and the bans of the heralds to the "walk up, walk up" of the puppet showman. In the *Spectator* of March 16, 1711, Steele intimates that Powell the showman exhibited religious subjects with his puppets under the little piazza in Covent Garden, and talks of "his next opera of *Susannah* or Innocence betrayed, which will be exhibited next week with a pair of new *Elders*," while the following droll specimen from Strutt's *Sports and Pastimes* also evidences to the performance of Mysteries in this country as late as the eighteenth century:—

"*By her Majestie's permission.* At Heatly's booth, over against the Cross Daggers, next to Mr. Miller's booth, during the time of Bartholomew Fair, will be presented a little opera, called *The old creation of the world*, newly revived, with the addition of the glorious battle obtained over the French and Spaniards by his Grace the Duke of Marlborough. The contents are these:—

1. The creation of Adam and Eve.
2. The intrigues of Lucifer in the Garden of Eden.
3. Adam and Eve driven out of Paradise.
4. Cain going to plough, Abel driving sheep.
5. Cain killeth his brother Abel.
6. Abraham offering his son Isaac.
7. Three wise men of the East guided by a star, who worship him.
8. Joseph and Mary flew away by night upon an ass.
9. King Herod's cruelty; his men's spears laden with children.
10. Rich Dives invites his friends, and orders his porter to keep the beggars from his gate.
11. Poor Lazarus comes a begging at rich Dives' gate, and the dogs lick his sores.
12. The good angel and death contend for Lazarus's life.
13. Rich Dives is taken sick and dieth. He is buried in great solemnity.
14. Rich Dives in hell, and Lazarus in Abraham's bosom, seen in a most glorious object, all in machines descending in a throne, guarded with multitudes of angels, with the breaking of the clouds, discovering the palace of the sun, in double and treble prospects, to the admiration of all spectators. Likewise several rich and large figures, with dances, jiggs, sarabrands, anticks, and country dances between every act: compleated with the merry humours of Sir John Spendall and Punchanello, with several other things never yet exposed. Perform'd by Mat Heatly. Vivat Regina."*

Enough, however, has been said and cited to show that the Miracle Play has an interest not so much for the antiquarian as for the student of culture. Our knowledge of the manifold causes which contributed to the moral development of England during the thirteenth, fourteenth, and fifteenth centuries would be very imperfect if we omitted the influence of this institution on a people among whom only portions of the Bible began to be circulated as late as the sixteenth century. It at least powerfully affected human conduct in supplying men with conceptions, rude and false though we now know them to have been, of a divine government of the world and a tribunal at which they would at the last be judged, but at the same time it did quite otherwise than contribute to the permanence of any one form of theology. In view of the political and personal causes which in England precipitated the Reformation, it is not easy to apportion to the religious plays of that period their share in the dethronement of sacerdotalism, and in the substitution of the authority of the Bible for that of the Church, which proved to be but an exchange of fetters; enough that they were on the liberal side, even when it seemed otherwise. For as the permanent in thought cannot be literalised and localised, the representation of the Deity in a linen coat and gloves could only quicken the advance of conceptions which refuse to surround Him with the limitations of Personality.

LIVE STOCK IN EUROPE.†

THE United States Consul in Copenhagen, writing on the subject of the live stock in Europe, says that the number of horned cattle throughout Europe is estimated at about 92,000,000, of horses 36,000,000, of sheep 200,000,000, and of swine about 46,000,000. Of the European States, the Scandinavian countries and Servia stand in a prominently favourable position as regards the relative amount of their live stock to the inhabitants, Denmark ranking first on the list with 755 head of horned cattle per 1,000 inhabitants, next Servia with 609, then Norway with 562, and, lastly, Sweden with 483. France may be taken as representing the European average, whilst below the average come Great Britain, Spain, Belgium, Greece, Portugal, and Italy. Of sheep, Servia has relatively the largest number, namely, 2,200 head for 1,000 inhabitants, and Greece with 1,496. Spain, Roumania, Great Britain, and Norway rank as above the European average, Denmark above the average with 777 head, and all the other countries below the average, the

* "Dodsley," Vol. I., p. 362.

† Langton sends to Cromwell, among other reliques, Our Ladies smock, parte of God's supper, a fragment of stone from the manger at Bethlehem, while Dr. London sends from the abbey of Reading "the principal relique of idolytrie within this realm—an angel with one wing that brought to Caversham the spearhede that percyd our Saviour his syde upon the Crosse." In the inventory of reliques in the abbot's house, we find "two peces of the Holye Cross, Saynt James his hand, a bone of Mary Magdalene, a chow-bone of Saint Ethelwolde." Vid. *Suppression of the Monasteries.* Camden Society, 1843, pp. 58, 227.

* *Coventry Mysteries*, p. 408. † *Journal of Society of Arts.*

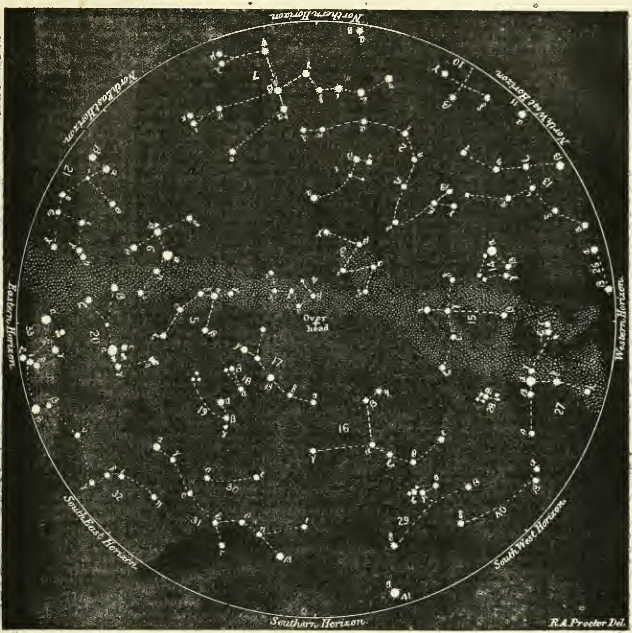
lowest in rank being Holland, Switzerland, and Belgium, with 121 head. Of swine, Servia has relatively also the largest number, namely, 1,062 head, whilst Spain, which follows next, has only 272, then Denmark with 263; Portugal, Austria, Roumania, and Germany being all above the average, France about the average, and the remaining countries below, the lowest in rank being Sweden, Holland, Italy, and Norway, with only 56 head. In an examination of the total numbers of live stock in the different countries, it will be found that Russia has the decided superiority, taking all classes of animals together. This country, including Poland and Finland, in the year 1876, possessed 25,000,000 head of horned cattle, 45,000,000 sheep, 10,000,000 swine, and 17,000,000 horses. The increase during the last twenty years has been greatest in sheep—about 20 per cent.; whereas the increase of horned cattle and swine has only been about 4 per cent.; and horses have remained stationary. Next to Russia, Germany has the largest number of horned cattle—about 15,000,000, of sheep 25,000,000, of swine 7,000,000, and of horses 3,000,000. In Prussia there has been, of late years, a considerable increase in all classes of animals; in Saxony and Baden it has been stationary; while in Bavaria, Wurtemberg, Hesse, and Oldenburg there has been a falling off. Austria, with Hungary, ranks third on the list, so far as horned cattle and swine are concerned, respectively with 12,000,000 and 7,000,000; in the second rank as regards horses, namely, 3,000,000, but only in the sixth rank as regards sheep, with 20,000,000. After Austria, France has the next largest number of horned cattle, about 11,000,000 head, while it only occupies the fourth place for sheep and swine, namely, 24,000,000 and 5,000,000, and 2,000,000 horses. From 1850 to 1872 there was a considerable falling off in horned cattle in France, but in later years there has been a steady improvement. Great Britain follows next in regard to horned cattle, namely, with 9,000,000 head; but, in respect to sheep, stands second on the list with 32,000,000; she takes the fourth rank in respect to horses, viz., with 2,750,000, but for swine only the sixth rank, with 4,000,000. Live stock in Great Britain has fallen off very considerably of late years; for example, from 1874 to 1880 there was a decrease of 500,000 head of cattle, 4,000,000 sheep, and 750,000 swine. Italy ranks last with respect to horned cattle, with 3,500,000 head, 1,000,000 horses, 9,000,000 sheep, and 3,750,000 swine. Of late years there has been a falling-off in the number of horned cattle, but sheep show an increase. In Holland the absolute number of live stock may be given as 1,500,000 head of cattle, 1,000,000 sheep, 500,000 swine, and 300,000 horses. The cattle interest in this country is of considerably more importance than the culture of cereals, about 40 per cent. of the land area being devoted to meadow and grass land. Denmark, in the cattle census of 1881, was stated to possess about 347,500 horses, 1,470,000 head of horned cattle, 1,548,600 sheep and lambs, and 527,000 swine. These figures, as compared with the previous census of 1876, show a very considerable increase in horned cattle and swine, while there is a diminution in the number of horses to the extent of 5,000, and in sheep of 170,000. In Norway, where the cattle interest is of more importance than cereal culture, the number of horned cattle is given at about 1,000,000 head, sheep at about 1,700,000, but of swine not more than about 100,000. Lastly, Sweden appears with 2,000,000 head of horned cattle, 1,500,000 sheep, 500,000 horses, and 450,000 swine. Taking the extra European countries, the United States comes first with its enormous and steadily-increasing amount of live stock, which, notwithstanding the large annual increase of population from natural causes as well as from the great tide of emigration annually pouring into the country, has been fully able to keep pace with its relative position to the population. According to the latest returns, the number of horned cattle in 1882 amounted to 41,000,000; of sheep and lambs, 49,000,000; horses, 11,000,000; and swine, 43,000,000. From Canada there are no later census returns than those of 1871, when the numbers given were 2,700,000 head of horned cattle, about 3,000,000 sheep, and 1,500,000 swine. South America has relatively a larger number of animals even than the United States, especially the La Plata States are noted for their enormous hordes. Statistics place the number of horned cattle at 19,500,000 head, with 70,000,000 sheep, and about 500,000 swine. In the Pampas the horned cattle are estimated at 30,000,000. In Algeria the number of live stock in 1879 was stated as 1,200,000 head of horned cattle, and about 9,000,000 sheep. As regards Australia, the stock of animals in these colonies has received a very great increase during the last ten years. In the census of 1878, horned cattle are stated as 7,400,000, as compared with 4,700,000 in 1876; sheep, 61,000,000, against 51,000,000; and swine, 815,000, against 695,000. The proportion of live stock to every 1,000 inhabitants is very large, being as much as 2,800 head for horned cattle, 23,400 for sheep, and 310 for swine.

FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*. the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.



NIGHT SKY FOR OCTOBER (Second Map of Pair),

Showing the heavens as they appear at the following hours :—

At 10 o'clock.........October 22.	At 9¼ o'clock.........November 3.	At 8½ o'clock.........November 14.
At 9¾ o'clock.........October 26.	At 9 o'clock.........November 7.	At 8¼ o'clock.........November 18.
At 9½ o'clock.........October 30.	At 8¾ o'clock.........November 10.	At 8 o'clock.........November 22.

EARTHQUAKES.

By Richard A. Proctor.

IT is related in the *Timæus* of Plato that the ancient Egyptians held the world to be liable to occasional widely-extended catastrophes, by which the gods checked the evil propensities of men, and cleansed the earth from guilt. Conflagrations, deluges and earthquakes were the instruments of the wrath of the offended gods. After each catastrophe mankind were innocent and happy, but from this state af virtue they gradually fell away, until their accumulated offences called for new judgments. Then the gods took counsel together, and unable to bear with the multiplied iniquities of the human race, swept them from the earth in some great cataclysm, or sent a devouring flame to consume them, or shook the solid earth until hills and mountains fell upon and crushed the inhabitants of the whole world.

One can understand how the confused records of great catastrophes, in which all, or nearly all, the inhabitants of wide districts were destroyed, led in the course of time to the formation of such views as Plato has described. And, indeed, it is not in one nation alone that

we find theories of this sort prevalent. In the *Institute of Menu* the Hindoos are taught that at the end of each of those cycles of ages which are termed the "days of Brahma," all forms of life are destroyed from the earth by a great conflagration, followed by a deluge which inundates heaven itself. The mythical legends of the Chinese refer to similar views, which appear also in the Babylonian and Persian cosmogonies. The Chaldeans taught that when the planets are all conjoined in Capricorn the earth will be overwhelmed by a flood, and that when a conjunction of this sort takes place in Cancer the earth will be destroyed by fire.

In the present age when the network of telegraphy brings all parts of the earth into close intercommunication, we are not likely to trace, even in the most widespread disasters, the approaching destruction of our globe. The same day which brings the intelligence of some desolating catastrophe brings evidence also that the devastation is but local. We are seldom informed of simultaneous, or nearly simultaneous, events happening in widely-separated regions of the earth's surface. Accordingly, we are seldom led to dread the occurrence of any widely-devastating series of catastrophes.

We have heard a great deal lately of certain speculations—recently ventilated by an American philosopher—which threaten the earth with complete annihilation. According to these views there is one great danger to which we are at all times liable—the risk, namely, that some large volcanic vent should be formed beneath the bosom of ocean. Through this vent the sea would rush into the interior of the earth, and being forthwith converted into steam by the intense subterranean heat, would rend the massive shell on which we live into a thousand fragments.

Whether it is possible or not that such an event as this should take place, I shall not here stay to inquire. Let it suffice that the risk—if there be any—is no greater now than it has been any time during thousands of past years.

But certainly, if there is any source from which the inhabitants of the earth may reasonably dread the occurrences of widely devastating catastrophes, it is from earthquakes. It is related that for full six months after the great earthquake of Lisbon, Dr. Johnson refused to believe in the occurrence of so terrible a catastrophe. "He spoke half jestingly," Macaulay thought—it is not easy to see on what grounds. To us it seems far more probable that Johnson heard with natural wonder and awe of the destructive effects of this fearful convulsion; and that for awhile he could scarcely believe that the extent of the disaster had not been exaggerated. It would be well if, indeed, the powers of earthquakes were less tremendous than they have been repeatedly shown to be. "There is," says Humboldt, "no other outward manifestation of force known to us—the murderous inventions of our own race included—through which, in the brief period of a few seconds or minutes, a larger number of human beings have been destroyed than by earthquakes." Lightning and storm, war and plague, are but weak and inefficient agents of destruction in comparison with the earth's internal forces.

And as earthquakes surpass all other phenomena as agents of sudden destruction, so the impression which they produce on those who for the first time experience their effects is peculiarly and indescribably awful. Men of reputed courage speak of a feeling of "intolerable dread" produced by the shocks of an earthquake, "even when unaccompanied by subteranneau noises." The impression is not that of simple fear but a feeling of absolute pain. The reason seems for awhile to have lost the power of separating real from imaginary causes of terror. The lower animals, also, are thrown into a state of terror and distress. "Swine and dogs," says Humboldt, "are particularly affected by the pheuomenon of earthquakes." And he adds that "the very crocodiles of the Orinoco, otherwise as dumb as our little lizards, leave the shaken bed of the stream and run bellowing into the woods."

Humboldt's explanation of the peculiar sensations of alarm and awe produced by an earthquake upon those who for the first time experience the effects of the phenomenon is in all probability the correct one. "The impression here is not," he says, "the consequence of the recollection of destructive catastrophes presented to our imagination by narratives of historical events; what seizes us so wonderfully is the disabuse of that innate faith in the fixity of the solid and sure-set foundations of the earth. From early childhood we are habituated to the contrast between the móbile element water and the immobility of the soil on which we stand. All the evidences of our senses have confirmed this belief. But when suddenly the ground begins to rock beneath us, the feeling of an unknown mysterious power in nature coming into operation and shaking the solid globe arises in the mind. The illusion of the whole of our earlier life is annihilated in an instant."

Use habituates the mind to the shocks of earthquake. Humboldt found himself able after awhile to give a close and philosophic scrutiny to the circumstances attending the phenomenon which had at first impressed him so startlingly. And he tells us that the inhabitants of Peru think scarcely more of a moderate shock of earthquake than is thought of a hail-storm in the temperate zone.

Yet the annals of earthquakes are sufficient to give rise to a feeling of dread, founded, not merely on the novelty of the event, but on a knowledge of the powers of the earth's internal heavings. The narratives of some of the great earthquakes afford fearful evidence on this point.

In the first shock of the great earthquake of Lisbon (November, 1755) the city was shaken to its foundations. The houses were swung to and fro so violently that the upper stories fell at once, causing a terrible loss of life. Thousands rushed to the great square in front of St. Paul's Church, to escape the reach of the tottering ruins. It was the festival of All Saints, and all the churches had been crowded with worshippers. But when the terrified inhabitants reached the square, they found that the great church of St. Paul's was already in ruins, and the immense multitude which had thronged its sacred precincts were involved in its destruction. Such of the congregations of the different churches as had escaped rushed to the banks of the Tagus for safety. There were to be seen priests in their sacerdotal vestments, and an immense crowd of people of all ranks and ages, praying to Heaven for mercy. As they prayed there came the second shock, scarcely less terrible than the first. The church on the top of St. Catherine's Hill was rocked to and fro till it fell, crushing in its fall a great multitude which had sought that height for safety.

But a far more terrible catastrophe was at hand. As the banks of the river sounded with the *Miserere* of the terrified supplicants who had crowded thither for safety, there was seen to pass over the wide expanse of the stream (here four miles broad) a strange heaving swell, though no wind stirred the air. The waters seemed to be drawn away to meet a vast wave which was now first

observed to be bearing down upon the devoted crowd. They strove to fly, but the wave swept too rapidly onwards. The whole multitude was overwhelmed in a moment. A magnificent quay, lately built at a great expense, was engulfed with all who had crowded on it for refuge. Numberless vessels, also, which were anchored on the river and were now full of terrified people—seeking on an unstable element the security which the solid earth denied them—were sucked down by the tremendous wave, and not a trace of them was ever afterwards seen.

A third shock followed, and again the river was swept by a gigantic wave. So violently was the river moved that vessels which had been riding at anchor in deep water were flung upon the dry ground. Other shocks and other inroads of the river-water followed, each working fresh destruction, insomuch that many began to believe that "the city of Lisbon was doomed to be entirely swept from the face of the earth."

It would be out of place to describe here at length how fire and pestilence came successively to complete the desolation begun by the earthquake's ravages. The terrible story has been narrated elsewhere. But what remains to be mentioned gives us startling evidence of the terrible energy of the earth's subterranean forces:—

The mountains Arrabida, Estrella, Julio, Marvan, and Cintra, some of the largest in Portugal, were shaken from their very foundations, they opened at their summits, and huge masses were flung into the neighbouring valleys. Flames and smoke were emitted from the openings. But much farther away the effects of the great convulsions were experienced. It has been computed, says Humboldt, that a portion of the earth's surface four times greater than the whole extent of Europe was simultaneously shaken. On the coasts of Sweden and on the shores of the Baltic, far away across the Atlantic to the Antigua Islands, at Barbadoes and Martinique, and still further off in the great Canadian Lakes, the movement was sensibly felt. A vast wave of inky blackness swept over the West Indian seas, rising twenty feet above the level of the highest tides. In Algeria the earth was as violently shaken as in Portugal, and eight leagues from Morocco a village with 8,000 inhabitants was swallowed up.

The shocks felt at sea were so violent that captains who experienced them thought their ships had struck the solid ground. A ship 120 miles to the west of St. Vincent was so violently shaken that the men were thrown half a yard perpendicularly upwards from the deck. Lakes and rivers in England were strangely agitated. The water in Loch Lomond suddenly rose against the banks without apparent cause, and then as suddenly subsided—the vibration of the earth's surface having travelled from Lisbon to Scotland at the rate of twenty miles a minute!

It has been calculated that in Lisbon alone 60,000 persons perished within the brief space of six minutes. But there have been other earthquakes in which even this terrible destruction of life has been surpassed. In 1693, 100,000 persons fell victims to the great Sicilian earthquake, and upwards of 300,000 persons are supposed to have perished in the great earthquakes which desolated Antioch in the sixth and seventh centuries. It has been estimated that within the last 4,000 years five or six millions of human beings have perished through the effects of earthquakes.

It is related that in the great earthquake of 1747 all the inhabitants of the town of Callao were destroyed, save one. The man who escaped, standing on a fort which overlooked the harbour, saw the sea retire to a distance and then return like a vast mountain in height. "He heard a cry of *Miserere* rise from all parts of the city," and in a moment all was silent—where the town had once flourished there was a wide sea. But the same wave which overwhelmed the town drove past him a small boat, into which he flung himself, and so was saved.*

THE COLUMBIA TYPE-WRITER.

By John Browning.

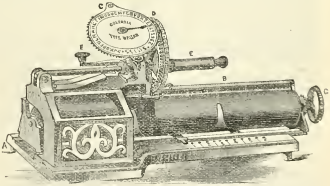
TYPE-WRITERS have just recently been making rapid strides, and they are now within a measurable distance of general adoption.

About thirty years ago I planned and began making a type-writer, and I do not suppose I was by any means the first person the idea occurred to. My attention was distracted from this idea by the charms of the spectroscope, and I have never returned to the subject since. But I have watched the production of the various type-writers with very lively interest, and used one occasionally for several years.

When I first adopted a type-writer I dispensed with the services of a shorthand clerk; but I soon found that no type-writer could arrange books and papers for me, and I therefore engaged one again. Yet I would never write any amount of matter with a pen in future if I could get a thoroughly-satisfactory type-writer. The Remington was brought out some years since, and it has been extensively adopted, and had it not been for the high price, about £20, it would doubtless have been still more generally used.

Since the Remington we have had the Caligraph machine, constructed on the same plan, containing some improvements.

Still more recently we have had several type-writers of a smaller size, and more economical in price. The Hall machine is portable and efficient, and the price is only £8. 8s. I have no experience of this machine, but I should think that it would be difficult to write with it quickly.



The Anglo-American type-writer I have not been able to see, though I have tried to get a sight of it, so that although it has been advertised extensively, I am not sure whether it is really in the market.

The latest type-writer introduced, and I should think, take it all round, the best, is the Columbia. In this machine the type is on the rim of a small wheel. When

* It must be remarked, however, that Sir Charles Lyell estimates the number of the saved at 200, "of whom twenty-two were saved on a small fragment of the fort of Vera Cruz, which remained as the only memorial of the town after this dreadful inundation."

the type-wheel is turned by means of a straight handle, held between the fingers, a hand points to the letter which is in the position for printing on a dial; simply depressing the handle then prints the letter on the paper, and raising the handle again moves the paper-carrier forward, and inks the type for the next operation. The act of depressing the handle locks the type-wheel, so that it cannot turn while the letter is being printed.

Excellent letterpress copies, two in number, may be made from the writing done with the Columbia; but six perfect copies may be obtained at one operation on the machine itself by using thin paper and carbon paper alternately.

The Columbia Type-writer weighs less than six pounds, and the price, with one wheel of type, in case complete, is only £5. 5s.; with two wheels of type, to print both capitals and small letters, the price is £6. 6s.

I have printed a few pages with the machine, and I find it very easy to use. When I have had some amount of practice with it, I will report further respecting the speed which may be attained, as this is an all-important consideration.

THE FACE OF THE SKY.

From Oct. 9 to Oct. 23.

By F.R.A.S.

Spots and faculæ continue to be visible at intervals on the Sun's face. Map X. of "The Stars in their Seasons" shows the aspect of the night sky. Minima of Algol will occur at 1h. 26m. a.m. on Oct. 20, and again at 10h. 15m. p.m. on Oct. 22. Mercury comes into superior conjunction with the sun at 10h. a.m. on Oct. 16, and will be, for all practical purposes, invisible during the next fortnight. Venus is an evening star, but is very badly placed for the observer on account of her considerable and rapidly-increasing south declination. If seen at all it will be over the south-west horizon just after sunset. Mars, Jupiter, and Uranus are all equally invisible for the purpose of the ordinary amateur observer. Saturn is visible during the late working hours of the night. He rises about 9h. 11m. this evening, and about a quarter past 8, when our notes terminate. Hence he is fairly high up by midnight. He continues to form a triangle with ε and ζ Geminorum. Neptune remains in the old blank region in Taurus. The Moon enters her first quarter at 1h. 20·7m. a.m. on Oct. 16, and is full on Oct. 23, at 9h. 22·6m. at night. No occultations of fixed stars occur during the period covered by our notes. When they begin the Moon is in Virgo, but at 7 o'clock this evening she will pass into Libra. She is travelling through Libra until 4 h. 30 m. p.m. on the 11th, when she arrives at the narrow northern strip of Scorpio. Passing through this, at 2 h. 30 m. in the early morning of the 12th she enters Ophiuchus, which she leaves in turn at midnight on the 13th for Sagittarius. She remains in Sagittarius until 2 h. 30 m. p.m. on the 16th, at which hour she crosses into Capricornus. She leaves Capricornus for Aquarius at 9 a.m. on the 17th; and Aquarius for Pisces at 3 p.m. on the 20th. Her passage through this huge constellation is not completed until 4 p.m. on the 23rd, when she passes into the north-west corner of Cetus. She is still there at midnight on the 23rd.

The *Chicago Railway Age* states that over 1,650 trains pass over the junction of the New York Elevated Railroads at Chatham-square every twenty-four hours. No railroad in the world does an equal train business on two tracks. There is a junction in London where 2,400 trains pass daily, but four tracks are provided for their accommodation. The only railroads in operation that compare with the New York Elevated Railroad system for crowded business are the London Underground Railways. The Underground Railways carry an enormous number of passengers, and the traffic has developed very rapidly. In 1879 a total of 91,420,178 persons were carried by the London Underground Railways, while in 1884 the number had increased to 114,417,514. During the corresponding five years the New York Elevated Railroads showed an increase from 46,045,181 to 96,702,620; in other words, while the Underground showed an increase of 23,027,336 in five years, the Elevated had expanded its figures by 50,667 430

Gossip.

By Richard A. Proctor.

I hope, in the next number, which will be the last weekly number of Knowledge, to give a full account of the probable form in which the first monthly number of Knowledge will appear. At present I note only that it will contain, besides the letter mentioned in the next paragraph (which many will regard as its chief attraction), an article by Mr. Grant Allen, on "Nature's Way of Spreading Seeds"; the opening paper of a series by Mr. Clodd, on "The Story of Creation"; a paper by a Fellow of the Astronomical Society, on "Colour"; the beginning of a series of papers by Mr. Mattieu Williams on "Coal" (in its commercial aspect), a subject which he has in a special manner made his own; a paper on "Indian Myths," by Stella Occidens; and probably a paper by Miss Ballin, on "Thought." I have not yet heard from other regular contributors. I begin a series of papers on the "Southern Skies," illustrated by maps prepared for the latitudes of Melbourne, Sydney, Cape Town, Dunedin, and other important southern cities; in fact, suitable for Australia, New Zealand, Tasmania, Cape Colony, &c., and likely to interest northern people who wish to know more than the books teach about the celestial phenomena of the southern skies. I also begin a series of papers on the religion of science. The "Face of the Sky" would no longer have the fitness which it had in Knowledge as a weekly; but monthly astronomical announcements will be made, and, perhaps, records of each past month's celestial phenomena. Chess will continue under the able management of "Mephisto," who has recently achieved such noteworthy success; and "Mogul," the skilful Whist-player, has promised a series of papers on Whist which cannot but be of great interest.

In the first monthly number of Knowledge there will appear a long and most interesting letter by Sir John Herschel, written in the year 1869, and hitherto unpublished. It relates to my own inquiries, then little more than begun, and presents in clear terms his ideas at that time, when—in the fulness of years but also in the fulness of his powers—he was resting after the close of his long and noble series of astronomical labours.

I propose to follow up that letter by some others in which Sir John Herschel discussed the theories which his father had enunciated. I hope hereafter to be able to publish in connected form some of the more important of the elder Herschel's papers. This is much needed.

In nearly every work on general astronomy which has been published during the last half-century, a certain theory of the stellar universe is described and illustrated. According to this theory the system of stars forms a figure which has been compared to a cloven flat disc. Near the centre of the disc is the sun, while around the sun a small circle is drawn, which is intended to represent a sphere enclosing all stars visible to the unaided eye. The portion outside represents a section of the cloven disc of stars,—the single extension on one side corresponding to the enormous array of the stars whose united lustre produces the light of the Milky Way where that stream is single, while the double extension on the opposite side corresponds to the arrays of stars producing the two streams into which along one-half of its course the Milky Way is divided. The theory and the illustration are

both referred, quite justly, to Sir Wm. Herschel, and the reader is further informed that according to the views accepted by astronomers of our time the system of stars really has the figure assigned to it by the theory so fully and so frequently described and illustrated.

Yet, surprising as it may seem, the theory referred to is one which Sir William Herschel himself has distinctly rejected, as not in accordance with the evidence he obtained during the progress of his researches. This "generally accepted theory" with which every reader of even the most elementary treatises on astronomy is familiar, is one which no astronomer who has read Sir William Herschel's works through can possibly accept as the true theory of the sidereal system. I know nothing which in a more marked manner illustrates the careless way in which our astronomical text-books are prepared than this,—that a theory which its own deviser rejected as unsound, has been presented over and over again as embodying nearly all that is known about the general structure of the sidereal heavens. One writer has borrowed the theory from another—neither inquiring into its real merits nor being at the pains to study the papers of the great astronomer who first propounded it; until at length it has come to pass that the few who have ventured to challenge the theory have been regarded as little less rash than the paradoxists who are always overthrowing the theory of gravitation.

I remember well the awe-struck—almost horror-struck—looks with which many of the Fellows of that very Society which might be expected to know best what Herschel taught, regarded me when I said that a greater astronomer than the propounder of the theory had overthrown it. "Sir Wm. Herschel put forward this theory of the stars," I remarked, "but it was attacked and overthrown more than a quarter of a century later by an astronomer of greater experience, by an observer far more skilful, by a theoriser at once more daring and more cautious. This man, the greatest observational astronomer that has ever lived, and excepting Newton himself, the astronomer who has most profoundly affected the views of men respecting the celestial depths, has pronounced that the theory of the star-system which appears in almost all the astronomical text-books of our day is not a sound one, because not based on trustworthy hypotheses. The astronomer who thus proved that Sir Wm. Herschel had been wrong was Sir Wm. Herschel himself. The appeal is from Sir Wm. Herschel in 1785, the most skilful and laborious observer of his day, to Sir Wm. Herschel a quarter of a century later, compared with whom, the Herschel of 1785, great as he was, was yet but a beginner." Many, if not most of those to whom I addressed these remarks, considered (I know well) that either I was mistaken or else that I was drawing somewhat largely on my imagination.

I was not aware when I thus addressed the Royal Astronomical Society that the German astronomer Wm. Struve had expressed precisely the same opinion. Here are the words in which, after summing up the labours of Sir Wm. Herschel during the years immediately following the enunciation of the theory of 1785, Struve speaks of the result to which those labours had led:—"Nous parvenons donc au résultat peut-être inattendu mais incontestable, *que le système de Herschel, énoncé en* 1785 *sur l'arrangement de la Voie Lactée, s'écroule de toutes parts, d'après les recherches ultérieures de l'auteur; et que Herschel lui-même l'a entièrement abandonné.*

It is strange that the country in which the elder Herschel received his scientific training should know so little of his works. We have to turn to German literature to obtain a satisfactory, though not quite complete account of Sir Wm. Herschel's researches. His own masterly papers are written indeed in our language, but those who would read them must search through no less than thirty-seven of the thirty-nine volumes of the "Philosophical Transactions," published between the years 1780 and 1818. England has not done what Wilhelm Struve urged her to do. She has not yet honoured herself by "honouring the memory of her greatest astronomer," so far as to publish "at least a complete and systematic edition of his works."* Nor again has the position which the work of the younger Herschel bears with respect to the labours of the father been adequately presented in any English treatise on astronomy, the subject being one which would naturally not receive at his own hands—in his fine "Outlines of Astronomy"—either exhaustive or sufficiently appreciative treatment.

A correspondent sends us the following amusing letter from the *Derby Daily Telegraph*, together with an article about the Derby ghosts from the same paper,—asking if we can wonder there are ghosts at Derby:—

Sir,—A correspondent in your Tuesday night's issue presents us with a sample of Mr. Proctor's statements, some of which are taught in our schools to the rising generation. Just imagine the editor of Knowledge being lauded and applauded for such burning imaginative utterances as the following:—That the earth, sun, and moon are planets, requiring millions of years' process to advance to the stage he states the moon to be in, "decrepid." Will the reader just compare this with the Mosaic account found in Genesis, that not quite six thousand years ago God created on the fourth day two great lights, sun and moon, to rule day and night, also for signs and for seasons. Thus the moon cannot be the sun's senior by twelve hours. Yet we are expected to believe it millions of years. I respect my Bible too much for that, and have learned to value its statements as true. Mr. Proctor also pretends to describe the roarings of a cyclone in the sun, also to give its velocity as 100 miles per second. Readers, think of these statements, and ask how these things can be determined on a body ninety-five millions of miles distant, a distance which no human eye can reach with the most powerful aid. If the sun was double its size and of ten thousand times the brilliancy they say it is, one million miles would place it out of our limit of minute investigation.—I remain, yours truly, E. T. Taylor.

Although of course such letters reflect discredit where they appear, I fancy Derby is well on a level with the best towns in England for general intelligence and education. My audiences there, both when I lectured recently, and when I lectured for the Gilchrist Fund, were among the best I have addressed.

The reduced telegraph tariff is one of the most successful hits the Post-office has ever made. Their estimate of an increase of thirty per cent. in the number of messages transmitted has been as nearly as possible realised. On the First the increase was nearer forty per cent., but that is accounted for by the immense number of messages sent for the sake of spending sixpence over the inauguration of the new scheme, which, so far, has worked as well as could be expected. The increase, as was anticipated, is considerably greater on the local traffic than on the provincial or "town to town" work, being for London as much as fifty per cent. It is noticeable that the increase in the actual number of messages is scarcely, if at all, felt in the instrument-rooms, the average length having been considerably reduced, and the addresses brought down to the lowest limit.

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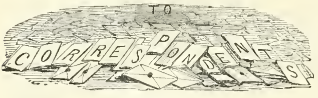
* Struve, in his "Études d'Astronomie Stellaire." In this work the labours of the Herschels are dealt with in the true scientific spirit—not with unquestioning acceptance, though with fullest appreciation of their value enhanced by the independent analysis to which the German astronomer has subjected them, while at the same time their intrinsic merit is made abundantly evident to the reader.



"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office,* 74, *Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

The Editor is not responsible for the opinions of correspondents.

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

No communications are answered by post, even though stamped and directed envelope be enclosed.

THUNDERBOLTS.

[1949]—I have frequently been struck by the fact of thunderbolts falling during violent storms, and of their simultaneous appearance with flashes of lightning.

That masses of matter occasionally accompany the electric fluid when it reaches the earth there is no question; they have been seen and described as "balls of fire," and I have in my possession one that fell some time ago at Casterton, in Westmoreland.

It was seen to fall during a violent thunderstorm, and, killing a sheep *en route*, buried itself about six feet below the surface, and when dug out shortly after it was still hot. In appearance it much resembles a volcanic bomb; it is about the size of a large cocoa-nut, weighs over 12 lbs., and seems to be composed of a hard ferruginous quartzite. I have not yet submitted it to a technical analysis, but hope to do so shortly. There is an external shell of about an inch in thickness, and this contains a nucleus of the same shape and material as the shell, but is quite independent of it, so that the one is easily separated from the other; I attribute this separation of the parts to an unequal cooling of the mass.

I have often wondered from whence thunderbolts were derived, and why they always fall as "balls of fire" accompanied by flashes of lightning.

It occurs to me that if ten millions of meteorites enter our atmosphere daily (*vide* Knowledge, Feb. 8, 1884), and become dissipated into vapour on coming into contact with our air, that some of these bodies might chance to survive the ordeal of passing through the more rarified zones and reach the earth, if only an airless passage could be obtained during the latter part of their journey.

By recent observations made on luminous meteors the height of the atmosphere is calculated to extend to about 200 miles. The pressure of the air at the sea-level being about 15 lb. per square inch (subject to variation), the density at a distance of 200 miles must be almost nil; in point of fact, at about 3 miles from the surface the pressure of air is reduced to $7\frac{1}{2}$ lb., while at a little over 6 miles it is only $3\frac{3}{4}$ lb. per square inch, for "as the elevation increases in arithmetical progression, the density and pressure decrease in geometrical progression."

Clouds in Great Britain reach an elevation of somewhere about 6,500 ft. (being considerably higher in tropical regions). I refer to cirrus clouds. Whether nimbus or storm-clouds have reached this height in Great Britain I cannot say, but that thunderclouds are usually at a considerable height is proved by the *large* drops of rain that fall during a storm; for the greater the distance the drops have to fall the greater is the amount of moisture they take to themselves on their passage throught a moist atmosphere.

Electric storms have been observed at a height of 16,000 feet; I presume that this was not in Great Britain, but, of course, the height of any particular storm-cloud may be ascertained by calculating the time the sound of the thunder takes to reach us (at a rate of 1,130 feet per second) from the moment the lightning flash is seen.

Let it be granted then that the densest portion of our atmosphere lies between any particular thunder-cloud and the earth, and that this presents the most formidable barrier with which meteorites have to contend when approaching us. Let it also be granted that many (specially favoured) meteorites reach the regions of the highest thunder-clouds from space before being completely vapourised by friction. Then it is only required to find some medium which will absorb the air through the final (and most trying) part of their journey, and so enable them to travel onwards to the earth in vacuo.

A fiendly discharge of electric fluid from the cloud at the right moment would do this, and a meteorite following in the wake of the flash that had thus prepared a way for it, would reach the earth as a "ball of fire," bringing destruction to everything that retarded its progress. C. Carus-Wilson, F.G.S., &c.

[Does the fall of a meteorite follow the electric disturbance, or does the electric disturbance follow the fall of the meteorite? —R. P.]

PARADISE FISH.

[1950]—Referring to the interesting account of the Paradise fish, which you quote from the *Scientific American* in your issue of Sept. 11, I notice that Mr. Holder alludes to the difficulty of transporting the fish of tropical waters to these latitudes. This I can corroborate from bitter personal experiences. Not only fish, but creatures so comparatively lowly organised as corals and molluscs, die on board ship of something analogous to sea-sickness, unless the tanks containing them are "gimbal-swung." But it seems to me that this undoubtedly great obstacle to the importation is not, after all, so nearly insuperable as to give occasion for marvel at the fact of two specimens of *Macropodus viridiflavus* reaching the States alive. Last week I saw a tubful of the closely-allied *Macropodus venustissimus*, in capital condition exposed for sale at the General Import Company's store, 177a, Euston-road, with the curious so-called "stalk-eyed" or telescope gold-fish, and other singular denizens of Eastern rivers. I once availed myself of a huge well-hung tank, originally constructed for the transmission of a manatee from Guiana (the apparatus and freight had cost something like £400, while the cow died the day after shipment), to endeavour to bring over some living flying-fish. They were put on board in splendid order at Barbados: the time of year was favourable, and the steamer one of the swiftest on the West Indian route; and I had prepared an arrangement whereby the temperature of the water in the tank (changed daily) could be raised when necessary. In fact, I spared no pains to ensure their safety, for I was offered my pick of the serpents at nearly every zoological collection in Europe in exchange for them—a very tempting bait to me. Yet they all died before we sighted the Azores. They were isolated from all rolling or pitching motion, but I suspect the vibration of the engines reached them. Arthur Stradling, C.M.Z.S.

Watford.

MUSIC—BREATHING—STAMMERING.

[1951]—I can appreciate "Kolokol's" desire, in middle age, to use his leisure for instrumental music. I am doing it myself in another branch. I sing. With the wish to please, not torture, my unlucky hearers, I am trying to prepare myself thoroughly.

The very first step I took opened out new worlds to me, in other directions, by teaching me *how to breathe.* I never knew before. I now find very few people who do know. Almost every one I meet on a tricycle or bicycle has his mouth open, thereby indicating a difficulty of breathing. An exceptional rider shut his mouth while looking at me in passing, but opened it again as soon as he got by. Although an athlete of some experience and success, I had always handicapped myself, and even endangered my health, by false breathing with the upper part of the chest. In many sports and handicrafts the muscles of the upper part of the chest are on a strain, and fix the chest walls so much as to render breathing by means of them both difficult and unnatural. One cannot easily expand the lungs against the opposition of so many muscles and the weight of the shoulders. The effort required to do it prematurely exhausts one, and evidently was never intended to be made.

On the other hand, when the diaphragm is used to expand and contract the lower part of the chest, the operation of breathing becomes perfectly easy. One's attention and energy are left free for the work in hand. One soon feels that the diaphragm was made to work the bellows, and one notices a welcome change in the aëration of the blood and the working of the heart.

I took up tricycling some eighteen months ago, and thought it rather an exhausting pleasure. But for the last six months I have been working at singing, and from that time have really believed there might be some truth in the enthusiastic cycling screeds one reads. I found that with diaphragmatic breathing I could do any amount of work without feeling nervous or exhausted. I can suit my breathing to my work with the greatest ease. In fact, I have been surprised to observe that I never think of my breathing even up the steepest hills I ride. I note a similar improvement in walking

Now, in the same way, stammering may be benefited. Of course, that term includes many ailments and eccentricities of speech, some of them depending on individual organisation which God has not given us the power to mend. But the art of breathing has now

fully taken its place as a practical and a useful art. If one learns to breathe properly even long-continued speech is made easy. Proper breathing may cure loss of voice, clergyman's sore throat, and many forms of stammering.

"Kolokol" has only to refer to Mr. E. Behnke, 12, Avonmore-road, West Kensington, to get the information he desires. He has taught me breathing, and I know he is a master of the subject. See, too, his book on "Voice, Song, and Speech," written with Lennox Browne. As Mr. Behnke knows nothing of this letter, I cannot say whether he or any one else would speculate in the manner proposed. I should think such a course would no more assure a cure than it would if taken by a fever patient with his physician. There is a limit to human art.

As to instrumental music, I fear there is no help in the direction "Kolokol" points out. Practice is the only panacea, and one's parents should encourage it in early youth. Science cannot provide new muscles; and even the success of Dr. Forbes's operation on the muscular bands between the little and fourth fingers, to free them for piano playing, is still quite undecided.

But I can assure "Kolokol" that, if he learns to breathe properly, he will notice a wonderful change in himself, and very likely stammering will disappear while learning. One caution may be added—viz., inexperienced persons should not carry the practice of deep or diaphragmatic breathing to excess. AN OLD STUDENT.

THE BIRTH OF WORLDS.

[1952]—If the formation and the decay of planetary systems be by the processes of progression and of retrogression, of evolution and of devolution, then one important consideration has been neglected by those who have speculated on the nebula, and on the sudden appearance of stars, and that is that light, as light, has no external existence whatever. Light is not of the stars, but is the effect of mechanical vibrations, propagated by their action, impinging on the sentient eye. It is therefore probable that there may be centres of systems, now in process of development, that have not yet the power of communicating to the circumambient ether sufficient vibratory activity to produce the sensation of light in human eyes, and not until they shall possess that power will their existence be revealed unto men. This consideration, too, would account for a dawning advent to a fuller day in the revelation of a star to human eyes; may it not also help to solve the mystery of the star in Andromeda? W. CAVE THOMAS.

[These stars, however, always "go in" again. How about that?—R. P.]

MERCURY BY DAY AND THE RED GLOW.

[1953]—On the 5th of this month the planet Mercury at transit by day became visible with my instrument for the first time for more than two years, and has been daily visible since. The copper halo round the sun, which has existed for the same period, and which has during the last six weeks diminished so as to be hardly observable, became considerably brighter again during a week of absolutely cloudless weather from the 13th inst. The fore-glow and after-glow have returned with increased splendour (accompanied almost each day by the pink arch in the opposite horizon), beginning on the 2nd to the 5th, and again from the 13th to the 23rd, that of the 22nd being finer than any yet seen here, continuing for one and a half hours after sunset, the glow extending along the northern horizon for some distance. Both the fore-glow and after-glow of the 22nd, as also the after-glow of the 2nd, 5th, and 23rd, were accompanied by bright rays of red running up half-way to the zenith.

I may add that the new star in Andromeda has been distinctly visible to the naked eye here, until the increasing moonlight prevented its being seen. M. F. W.

Partenkirchen, Bavaria, Sept. 28.

LETTERS RECEIVED AND SHORT ANSWERS.

HALLYARDS. I thought you had no show of a case in your correction of Miss Edwards's chronology; agreed with Mr. Allen; and with Miss Ballin; differed altogether from you about past fauna; never held that life has ceased on Mars, but the contrary (as probable). Brown Sequard and I both referred to measurement for new hats—as well as to the fit of the last worn. Yet I valued your letters for lively way of suggesting new thoughts, even though mostly wrong or inexact. I never said your letters were all bosh—or said that of any of them. I cannot remember what sarcasms you wish me to forgive. Suppose it recalled to my memory and forgiven: it is certainly forgotten. I really think I can honestly say that sarcasms roll off me as water from the duck's back. As for unfairness—what letter of defence have I suppressed, *except one beginning with the remark that you would not read the letter you meant to answer?* But you have sent in more matter since the approaching end of weekly KNOWLEDGE was announced than there was room for, if all other letters had been excluded. You know little about "the gift of editing" if you suppose it includes putting gallons into half-pint measures. About the condor question the authority you quote is simply valueless, because actual measurement has long since disproved what an "authority" who had never even seen a condor, supposed. The master-mind who put "abutere" for "abuti" and "patientiam" for "patientiâ" was certainly not mine, nor the mind of any "Cambridge graduate." So far as I am concerned you will find the very passage, with *verbatim* translation in a not very aged number of KNOWLEDGE. If it pleases you to assert or insinuate that I believe in a Latin verb, *uto*, infinitive *utere*, to use; and that I am ignorant that "ab" in composition is followed by an ablative, I am sure I have no objection. Those are not the only mistakes you have made. But now if you supposed me really sensitive, you should have suggested the alternative that I must have written my replies very badly, and so perhaps sent the "reader" to look up—more or less hurriedly and so imperfectly—the original passage, or to recall it imperfectly from memory, or perhaps to correct it from his inner consciousness. You would have been nearer the truth that way. Yet, sensitive though I seem to be, according to your judgment, I could have borne even that terrible sarcasm, knowing that I wrote in pencil, in a joggling train. Albeit I can write pretty badly when the spirit moves me, without being joggled at all. Will this do? Yet I would wager a brass farthing, if I had one, you will *take* the last word which you ask for so piteously.—There are so many things I do not know that I see no "gibe" in telling you that you are quite mistaken about meteors not moving under attraction. Let them move as fast as they may their paths must be curved. As to the *Saturday Review*, the opinion I expressed here is universal among well-informed persons. One may say of the class of writers they employ something akin to what was once said of a paradoxist,—He is only a chemist among astronomers, only an astronomer among chemists, and both only among those who are neither.—FACIEBAT. No; the second "patientiam" was not a printer's error; the first was. In the second case I was *quoting the error*. The other mistake was A Buty, too. Then "quosque" for "quo usque." But there are excuses. And sometimes the very care and anxiety taken to make out the meaning of my bad writing causes error,—as in this case, I expect. (I am writing *this* in a train nearing Exeter, and have been writing replies and posting—at Basingstoke, Salisbury, Yeovil—besides sending off letters, writing "Gossip," and what-not, ever since I left Waterloo; I shall see no proof of this; and what the printers cannot make out—small blame to them!—they will puzzle out as best they may). *That*, if I may be permitted a colloquialism, is the special form of inconvenience experienced by "Hannah." Know nothing about the misprint *gentum* for *gentem*, page 265, *note*,—not having seen any proof of the article in question, or read it in KNOWLEDGE itself.—F. C. 1. Do not know Hitchcock's "Religion of Geology;" from the little I have heard of it I should say it was scarcely a trustworthy book. 2. Mitchell's "Orbs of Heaven" is fairly trustworthy. His explanation of dynamical matters quite unsound. Of course, in some respects the work is out of date.—F. H. V. I am sorry the criticism annoyed you. As I read it, it seemed to express no opinion one way or the other between you and phonographers; while the critic admitted that (as you point out) what he said about your signs applied to all stenographic systems. I have not seen your book; nor have I seen one book in ten or in fifty, of those reviewed in KNOWLEDGE during the last eighteen months. Thanks heartily for your kindness at Christchurch. What a pleasant time that was to me!—J. SILCOCK. The present volume will end Oct. 16.—J. P. BROCHELL. I really do not know.—ONE WHO, &c. You somewhat amuse me in your apparent unconsciousness of your degraded position. "One who" writes anonymous letters *ought*, according to an old proverb, to have a better memory than you seem to have. For you certainly wrote "to that defect." As for the person you name, it so chances that he has done precisely that thing, and I knew it. Therefore I did him no injustice. I think I could put my Index Finger on *you*, if it were worth my while. I have not KNOWLEDGE for August 7th by me, so cannot find out why I am to be sorry for the remarks about Vegetarianism, which I doubt not were perfectly just—since you say they were unjust. Considering our food supply *per se*, and without fighting over tastes, we find it insufficient enough for our wants, without cutting down its best part. For, the history of ages shows that man cannot rise to his best without animal food, any more than a greyhound can do his full work if low fed. The individual can live on vegetable food, because of the stored-up energy given him by his ancestors. But it is a bad look-out for his children. You are quite right, we do not warn off anonymous writers. I am speaking of those really anonymous, and also of those who make personal attacks under that supposed cover; neither does a host warn off pickpockets by placard from the dining-room where he entertains his friends.—MISS A. Regret that we have no opening in that direction.—J. T. I do not know if lions and tigers have ever been fed for any length of time on vegetable food. I should not care to meet an animal of this kind, in a casual way, after he had

lived a month or two on a strictly vegetable diet.—N. E. B. Should not care to answer your question about conduction of heat without experimental tests. Other questions answered elsewhere. Thanks for list of errata.—H. O. C. I meant non-reappearance (nice word). It was not I who said all the matter of a comet might be put into a cocked hat. I do not know the capacity of a cocked hat, or believe comets to be so utterly insignificant anyway. From experiments made by Prof. Wright, of Yale, it appears probable that finely-divided cosmical dust *in vacuo* would be rendered incandescent, and in part vapourised.—W. Aston. I believe no such works exist. But for reference I may mention the edition of the "Encyc. Brit." preceding the present.—W. C. T. You deem me more altruistic than I am. Knowledge has changed in form chiefly because I could not longer stand the burden. My time and work since Knowledge started were simply *given away*. Computing at the average value of my time to myself, I find the gift was a large one. I could afford to make it no longer.—Omega. I am away from books of reference, and am unable to give you the title of any book of logarithms giving what you require.—A Correspondent (whose initials have unfortunately been torn off MS.) asks whether Dr. Ball's or Mr. Lockyer's astronomy is the more trustworthy. I have seen no edition of the latter work except the first, which was full of blunders (used for the supply of awful examples at Cambridge), and the American edition, which has been carefully corrected. Anything Dr. Ball writes may be regarded as thoroughly trustworthy. Or course he makes mistakes as we all do; but not from insufficient knowledge or power.—C. Carus Wilson. I should attribute the red sunsets to meteor dust. As regards thunderbolts, &c., I imagine that though electrical phenomena may often accompany the downfall of a large meteorite, no mass could possibly fall like a meteorite *because* of electrical disturbance.—J. L. Polack. You ask why do we deal with the 2/9 of 4/11 before the 3/5 + 2/9, when considering the expression 3/5 + 2/9 of 4/11. If you were told you were to receive 3/5 of a certain sum, and also 2/9 of 4/11 of the sum, would you begin to determine your share by adding 3/5 to 2/9? What earthly meaning would such a process have? You would first find what 3/5 of the sum amounted to, then what 2/9 of 4/11 of the sum amounted to, and then you would add the amounts together.—G. E. In about four hours I could give you about as much advice as you require. It would probably be all wrong, as I have no means of knowing your aptitude for the study on which you propose to enter. On the whole, it will be better to suppose your letter received a few weeks later, when no earthly power will persuade me to answer a question in Knowledge. — N. E. B. Thanks for the curious example of mental inequality. Possibly Guillemin's "Heavens," translated by Mrs. Lockyer, edited by Mr. Lockyer, and corrected by myself, might suit you. You are quite right about books of an untrustworthy sort being read as if by authorities. Glad to have made that ruddy eclipse matter clear. There was a curious example there of mental inequality, for that writer cannot even now see what is clear to many who have not half his acquaintance with some scientific matters. But such slips are unfortunate. As you for instance, in botany, your special subject, see blunders at once and want to know whether books on other subjects are as untrustworthy, so may many feel in studying papers on other subjects in which a writer is supposed to be proficient, after seeing that such a writer may have been very positive and even dogmatic when altogether in error. For that reason I regard the correction and ready admission of error as the sacred duty of a teacher of science. It is also, like honesty, good policy; but that is a mere accident of the position.—J. Russell, C., Qy.[2] Qy[2]. That quotation was marred altogether not a little: by that printer's devil, or (which is the same thing) that devil of a printer: not identified, so this is not personal. Would like well to lecture at Kingsbridge; but do not know how it may be managed.—Jas. Meredith, K. T. M., Constant Subscriber, J. M. Allen, Albert Howell, L. Means, Wearied One, Thos. Synington, and others Glad to find the proposed curtailment of correspondence meets your views.—G. Hailey. Apply to publishers.—J. Borrodaile. Oh why do you send us such nonsense? Abuse science to your's heart's content; but post your packet of nonsense in a pump, or a stove, or in any chance opening in a quarry. You will get just as much relief, and no one else will be troubled.—Commentator. That must have been the acting editor, for I never read such a paper.—Jas. Fraser, Jun.—One is an alteration of direction, the other of distance. Deflect a telescope through a very small angle, and it will bear on a widely different point on the horizon; but shift it ten feet, keeping its direction unchanged, and no appreciable effect will be produced.—X. Ah! You think any nonsense, even the rubbish written by Parallax, a Lady Mathematician, John Hampden, and other foolish persons, might be written by any one who is an admirer of Herbert Spencer. Interesting information truly! Possibly you do not know what nonsense those three *have* written. The middle one in particular was a twaddler "of the first water," having little claim to either half of her assumed name.

Our Inventors' Column.

*We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (*Knowledge *being a popular magazine) than is accorded by the most excellent trade journals.*

THE COMBINATION EASEL DESK.

This desk, introduced by David Clarke & Co., Small Heath, Birmingham, is the result of careful study of the requirements of an art-student. It is very light, simple, and compact, there being no complicated machinery of any kind about it. It is rendered equally applicable for drawing, painting, clay-modelling, or writing by the raising and adjustment of the desk top.

The top of the desk is hung with hinges upon the front side, and is adjusted to any desired slope by means of a toothed rack. On the front edge of the desk top is a movable ledge, consisting of a bar of metal in which are slots of an L shape, through which pins are made to pass, and by which it is fixed to the top. This ledge forms a rest for the drawing-board, canvas, or cast, whilst, when not required for that purpose, it can, by means of the vertical and longitudinal slots be depressed below the level of the desk-top, leaving the top free from projection for writing purposes. A movable and adjustable light metal frame, for holding copies, objects, casts, &c., is fixed to the back part of the desk-top, and is so constructed that it may be adjusted to any inclination to the desk-top, or, for convenience, be lowered down behind it out of the way. This is effected by means of a slot, pin, axle, and quadrant rack, so that by lifting the whole rail the length of the slot the student is enabled to place the copy or cast in the best position for work. One advantage of this frame is that the object to be copied, whether drawing or cast, is not foreshortened, but can always be kept at right angles to the student's eye. On the left-hand side of the desk is provided a space for the reception of drawing-boards when not in use, and also a receptacle for pencils, instruments, &c. There is also a water-pot for colouring purposes, carried in a fixed or swinging bracket, and fixed to one of the legs, or on the side rail of the desk, according to choice, and a hole is left in the desk-top at the back and on the right-hand side for the reception of this pot, so that it may be used when the desk-top is not inclined. The desk is said to be fast gaining popularity in the Midlands, for its simplicity and practical adaptability to the requirements of an art student.

PORTABLE CAMERA STAND.

Mr. Ashford has patented a portable camera stand, in which each leg is composed of three pieces; one forming, when extended, the bottom half of the leg slides between the other two pieces. On the inner sides of the pieces which form the upper half of leg grooves are cut dovetail in shape, and on each side of the sliding piece are corresponding pieces to fit in these grooves. Two brass clips fasten together the lower end of the upper half of stand, and a brass screw with milled nut passes through the upper end to fasten the leg to the head. Across the upper end of sliding piece are cut two grooves, one on each side, about an inch wide; into these grooves are fitted two cheeks which extend across the sliding piece on to the two pieces which form the upper half of leg. Right through these (the sliding piece and cheeks) is passed a brass screw with milled head, and at the back is fastened the nut. By merely loosening this screw the sliding part may be moved freely up and down, and can again be fastened in any required position. The head is made triangular in shape, and has three hollow projecting ears, the width of which corresponds with the sliding part of leg. Across these ears grooves are cut to fit the screws in top part of leg. Underneath the head and across these grooves are placed springs, so that when the metal pins in top end of legs are pushed along these grooves they are held safely by the springs until released. The advantages claimed for this stand are its firmness, portability, the facility with which it is set up and taken down, simplicity of manipulation, and the fact that having a long slide, it can be used on the side of a hill or on any uneven ground as easily as on the flat.

Our Whist Column.

By "Five of Clubs."*

HOME WHIST.

THERE is no reason why Whist should not be far more in vogue as a home game than those mere chance games at cards which seem regarded as the only games suited to the intelligence of a family party. My own experience has shown me that much better Whist can be played in the home circle than an average club table will supply; while Home Whist is free from the annoyances and rudenesses too often observable in Club Whist. Unfortunately, Whist played at home is usually, for want of a little instruction in Whist principles, so very bad, that few care to sit down to it. My chief object in this little treatise is to show how Home Whist may be made at once interesting and profitable: interesting because of the wonderful variety and beauty of the game itself; profitable because, while it is an amusing recreation, it is one which has the great advantage of taxing skill and exciting pleasant and wholesome emulation.

At the outset, I must make a few remarks on the laws of the game, on the best plan for obtaining that due observance of the laws without which Whist loses half its interest, and on the method of playing which is best suited for home play.

Club players, who are usually most unequal in skill as well as in that care which should almost wholly obviate occasion for referring to the code, are very strict in exacting penalties for mistakes, whether of omission or of commission. The long list of laws which they require to know (*ninety-one!*) would be quite out of place in Home Whist, as also would be the squabbles which these multitudinous laws appear to engender. (My own belief is that the stakes played for in clubs, whether guinea points or only shilling or sixpenny points are in question, are the real cause of most of the disputes and of much of the bad temper too often shown in club play.)

Yet there can be no doubt that, to be really enjoyable, Whist should be played strictly. Home players should try to show, by strict attention to the rules, that money stakes are not essential, as most Whist players contend, to the enjoyment of sound Whist.

Therefore, without adopting the complicated, ill-worded, and in some respects imperfect code used in clubs,† let us consider a few rules, in accordance with the accepted code, but suited for home play.

In family play, it is best to arrange the players according to some system agreed on beforehand, instead of cutting for partners. Thus, either a systematic rotation of arrangements may be adopted, each player having each of the rest for partner in succession, or else, where there are always the same four, the same pair may for a long spell of time be matched against the other two.

In cutting for deal the lowest card wins the deal; and *for this purpose* the cards range in value thus: Ace, lowest; then two, three, &c., to Knave, Queen, and King, highest.

It is best to use two packs. Dealer's partner makes and shuffles the cards, and places them on his (own) right, ready for the next dealer. The dealer may shuffle the cards afresh if he likes, before placing the pack beside the player on his right to be cut.

Any mistake in dealing which cannot be corrected without counting the cards or altering the position of more than one card is a misdeal. It is better perhaps, even in home play, to let a misdeal lose the deal. Yet if all are agreed that they care more for the play than for mere trick-making, there is no real occasion to waste time in a fresh deal, where the hands can be easily rectified. But where the dealing has been so careless that one or more cards have been exposed, it is not right to condone the fault, for the play cannot but be affected by knowledge of the position of any cards besides the trump. Let the deal in that case pass to the next hand, as it would in club play. When this has happened once or twice the careless dealer will show marked improvement.

The trump card should remain exposed until it is the dealer's turn to play to the first round. It is a good habit for the dealer to systematically place the trump card in his hand before playing to the first trick. After this, the other players may not ask what is the trump *card*, but only what is the trump *suit*.

In playing, it is well to be neither hasty nor too deliberate. Hurried play, besides leading to faults of strategy, results often in offence against the laws. Leading out of turn should be regarded as an offence for which the full penalty must be exacted, even in home play; *because it often gives an otherwise unfair advantage*. That in reality is the only point to be considered in applying the laws to home play,—viz., to secure fair and equitable strategy. If my partner takes a trick with the Ace and I hold the King of the suit, I may show him by leading that King, when it is not my turn, the way to a great game: in this case it is not sufficient to call on my partner to lead instead; it is only right and proper to call upon him to lead some other suit, if the adversaries wish. So in all such cases the rigour of the law may be properly applied; for nothing tends more to impair the harmony of Home Whist than the loss of tricks, be they few or many, through an inadvertence of one of the adversaries. Instead of saying in such a case *afterwards*: "It was not right to show that card, for it put your partner in the way to make a trick or tricks which otherwise we should have saved," the proper thing, in home play, is to say *at once*, but pleasantly: "That card tells your partner too much" (showing how it does so): "we are sorry, but, that your mistake may not cause us loss, we must call for a suit, even at the risk that we may gain a trick or so through your mistake."

If a player throws his cards on the table supposing the game won or lost, those cards, according to Club Whist, may be called; and I have seen cases where a sure game has been lost through this bad habit, and others where a game not really lost has been made a lost game by the enemy calling the cards in destructive order. In Home Whist, or wherever the play is not for money, all that should be required, where a player throws down his cards claiming a won game, is that he should show how the game may be surely won against any *play*, even though it could not be won if the enemy named in particular order the cards he was to lead. And in like manner if a player throws down his cards under the impression that the game is lost, his partner, if he sees a way by which the game might have been saved, should be entitled, in *Home Whist*, to save the game if he can against the best play by the enemy,—only this must be done independently of knowledge gained by the exposure of the cards. Of course, this is heresy to many club players, who regard the saving or winning of a game by calling the cards in such cases as among the choicest treats Whist affords. But Home Whist should be a more generous game. It is a good rule, though, never to expose the cards, except in absolutely certain cases.

(To be continued.)

Stoopid.—(Since you *wish* to be so called.) Can you give any reason for playing Heart Ace (in second line of play), when Heart Six will take the trick? I cannot.

* From the forthcoming little work on "Home Whist," by Richard A. Proctor.

† It is given in full in my treatise "How to Play Whist," and is worth reading if only as a curiosity for its bad English.

An Eclipse of the Sun.—To convey anything like an adequate idea of the effect of an eclipse on different minds, the writer can hardly do better than describe the eclipse he witnessed in Egypt in 1882. On the banks of the Nile, about one mile north of the town of Sohag, a large concourse of spectators was assembled to witness the forthcoming spectacle. A small party of these spectators were gathered around a number of instruments, doubly protected from the injurious sand-winds by stockades of rushes and by tents. A space extending about 300 yards, and enclosed on each side by the Nile and the outskirts of a grove of acacia trees, scarcely 200 yards away, was guarded by a body of Egyptian soldiers. Protection was only wanted from incursions of the curious; but had the natives been less informed of what was to take place, Egyptian soldiery, only a little less cowardly than the felaheen, would have been small protection against any fanatical outbreak. The river was lined with steamers, dahabeahs, and smaller craft, whilst to the south of the encampment, on the sloping bank, were gathered a large concourse of the inhabitants of the neighbouring villages, squatting on the sand in their peculiar Eastern fashion. The eclipse began and made some progress before the unscientific spectators noticed that the sun was fast disappearing; but when they became aware of it they gave vent to their feelings by a low moaning, the sound increasing in volume as the moon passed on. The alarm now spread to the feathered spectators, who, becoming at last cognisant of the rapidly waning light, rushed cackling hither and thither, into steamboat or into observatory, in search of a place in which to roost. At last a thin streak only of light was left; it disappeared, and there was a sudden change from weak daylight to a dull violet, which threw on the neighbouring scenery a weird, ghastly hue. At this moment a sudden shout arose from the crowd —a shout unheeded, scarcely heard, by the astronomers, who suppressed their excitement, and endeavoured to make the most of the seventy seconds during which totality was to last. And yet even they were taken off their guard, for alongside the brilliant corona was seen a small, but vivid, scimitar-shaped comet—a stranger unexpected, and never afterwards traced. Little wonder, then, if the regulation forbidding speech was for a moment disregarded. The short seventy seconds were soon over, the last observation made, and whilst one set of spectators were raising their thanks to Allah, the other had laid aside their calm reserve to join in mutual congratulations.—C. Ray Wood, in *Cassell's Family Magazine*.

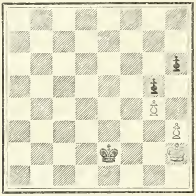
Our Chess Column.

By Mephisto.

DIFFICULT POSITIONS.

THE following neat End Game study, according to an American contemporary, originated in a match game played at New York:—

BLACK.



WHITE.

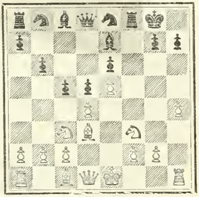
Black to move and win.

This is a position which may easily occur. White threatens P to R4 and K to R3. If Black plays K to B6. P to R4, K × P (best). P × P, P × P. K to Kt2 the game would be drawn, as White has the opposition. But Black can win in the following curious manner:—

	K to B7
P to R4	P to R4!
K to R3	K to B6

and whatever White does, Black will be enabled to gain a move by checking, and Queen first, and win.

BLACK.



WHITE.

THE above position occurred in a game played last week. From the nature of the position our readers will readily recognise this to be a game at the odds of Pawn and move. White has driven the Kt back to K sq. by P to K5, and has taken advantage of Black Castling prematurely, in order to direct his attack against the weak K side. Black seeks to engage White's attention on the Q side, where he threatens to displace the B from his advantageous position by P to B5, or to play P × P followed on Kt retaking by B to B4. The game proceeded with:—

10. Kt to KKt5 — B × Kt

This is forced. If Black plays P to Kt3, White can reply 11. Kt × RP, and if K × Kt White mates in four moves, beginning with 12. Q to R5 (ch). Then again, if Black plays 10. P to KR3, White would continue with 11. Q to R5.

11. B × B — Q to B2

This move serves the object of attack, Black thereby threatening the KP after P × QP. True, White can attack the Q by Kt to Kt5, but then the Q plays to Q2, threatening P to B5.

12. Q to R5

An ill-judged move. White intended forcing Black to advance his KKtP, so that after retiring his Q, he should be able to attack the P by P to R5. The strategy is good in itself, but did not take account of Black's obvious intention against White's centre, in other words, the counter attack.

	P to Kt3
13. Q to Kt4	P × P
14. Q × P	Kt to QB3

and Black won. Black's play shows that his success was due to an effort at a counter attack, which he combined with his defending moves. White, on the other hand, lost the game by not pressing his attack with sufficient vigour in a position in which he could easily have obtained a won game. Thus, either on his 10th or 11th move, Black, by sacrificing his B, could have forced a win. Similar positions occur often, but it seems not often enough to be known even to strong players. It is very seldom indeed that Black has means of meeting the attack resulting in similar positions from B × RP, Kt to Kt5, and Q to R5. In this game, White ought to have continued as follows:—

10. B × P (ch) — K × B

Of course neither K to R sq. nor K to B2 would do any good, on account of 11. Kt to Kt5 (ch), &c.

11. Kt to Kt5 (ch) — B × Kt

If K to Kt sq., then 12. Q to R5 could force Black to take the Kt. Neither is K to Kt3 feasible, on account of 12. P to R5 (ch).

12. P × B (ch) — K to Kt sq.

13. Q to R5

Threatening 14. P to Kt6 and mate on R8. This leaves Black absolutely no resource but

R to B4

So far White mentally analysed the position on his 10th move, and seeing no immediate win he abandoned 10. B × P or 11. B × P in favour of his adopted continuation. But he could soon obtain a winning advantage by

14. P to KKt4	R to B6
15. P to Kt6	K to B sq.
16. B to Kt5 and wins.	

Mr. R. A. Proctor's Lecture Tour.

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1. LIFE OF WORLDS
2. THE SUN
3. THE MOON
4. THE UNIVERSE.
5. COMETS AND METEORS
6. THE STAR DEPTHS
7. VOLCANOES.
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March 1, 3, 5, Maidstone; March 3 (afternoon) and March 6 (afternoon), Tunbridge Wells; March 9, 11, 13, 16, Belfast.

NOTICES.

Part XLVII. (September, 1885), now ready, price 1s., post-free, 1s. 3d.
Volume VII., comprising the numbers published from Jan. to June, 1885, now ready, price 9s.
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LONDON: FRIDAY, OCTOBER 16, 1885.

Contents of No. 207.

THE ECLIPSED MOON SUNLIT.

By Richard A. Proctor.

(*Continued from p.* 307.)

THERE remain some points which apparently confuse even "men who can render a reason"—for most of their views at any rate.

In the first place, to see an object, even in a distorted form it is necessary that we should do more than merely get light from it. Rays starting from each point of an object must be gathered into a focus on the retina of the eye if that point is to be discerned as such; and by the combination of such focal images of the different points of an object there is formed on the retina an image of the object, more or less correct in its proportions. This is true whether the object is looked at directly, or through various media, and whether these be diffuse or formed into particular shapes, as lenses, mirrors, and so forth. And though we need not expect anything like perfect vision in the case of the sun supposed to be seen through the earth's atmosphere from a point on the moon's surface during total eclipse, yet we ought to be able to show that each point of the sun would be visible as such, with suitable focal adjustment of an imagined lunar eye: (the adjustment would be different for different points, and that would prevent distinct vision of the ring-shaped image of the sun as a whole, but any zone for which the eye were adjusted would be visible.)

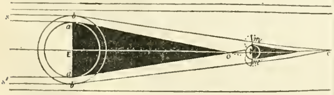


Fig. 2.

Now here comes in what has proved an exasperating difficulty. Some students imagine that c (Fig. 2) is the focus for all rays skirting the earth's atmosphere as at a and a', a different focus somewhere along $c\,c'$ resulting for rays through each layer of the air above the sea-level. And, as an imagined observer at M could not possibly get sunlight proceeding as from a focus at c or c', a vague sort of mystery spreads itself over the whole inquiry. How *can* he get light from those parts of the sun which are obstinately bent on making their rays focus at c or c' or anywhere except at M, where the student supposes that a focus is wanted (which is very far indeed from being the case)?

This difficulty, or rather this bundle of difficulties, has its origin in a double mistake. First there is the idea that an atmosphere like the earth's may be regarded as if it were a spherical shell, part of a spherical lens of some such substance as glass; and secondly there is the idea that a spherical lens—regarded as a whole—has a *focus*. As matters of fact:—First, the different density of the atmosphere at different heights causes it to be as unlike a spherical lens, or a shell of such a lens, in its action, as a concave lens is unlike a convex lens; and secondly, a sphere, though it has a definite focus for rays passing near its centre, has a great number of foci for rays which pass through different parts of it, and these foci are not centrally situated, like the focus for rays traversing the sphere centrally.

The second point does not concern us much, except in so far as it serves to measure the incorrectness of the ideas commonly entertained about the action of a sphere as a lens. But the first is of essential importance.

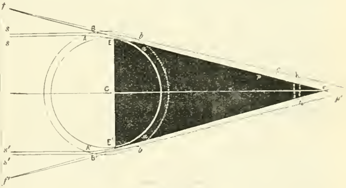


Fig. 4.

Thus, suppose E E′, Fig. 4, to represent the earth, S A a c, S′ A′ a' c the course of two rays from a point on the sun through the air along the curved lines A a, A′ a', just grazing the surface of the earth at the opposite points E and E′, and crossing at c the prolongation of the line from the point on the sun through C. Let s B b c', s' B′ b' c', be two rays from the same point passing above E and E′ at the same height and crossing C c produced in c'.

Now, if B b b' B′ were a homogeneous sphere, the foci for the rays S A, S′ A′, s B, s' B′, would not be on C c'. The rays S A, s B after refraction might converge to a point as k and the rays S′ A′, s'B′ to a corrresponding point k', the whole set of rays at the same distance from the line C c c' converging to a focal ring as k k'. Even this would be so remote from the common idea (the common mistake) that all these rays converge to some point on C c' as to justify my remark that in the case of the ruddy eclipse question, the ray S A has no more connection (focally considered) with the ray S′ A′, than the last ray of the setting sun yesterday with the first ray of the rising sun the day after to-morrow.

But under the actual circumstances of the case, the emergent rays a c, b c', do not tend to a focus on *that* side

at all. The ray $b\,c'$ having suffered less deflection than the ray $a\,c$, these rays, which had already been slightly divergent when they fell on the air at A and B, are now become more divergent, and proceed from a virtual focus situated as at f, only much farther away relatively from the earth. Similarly the rays S′ A′, s' B′ after refraction along the curved courses A′ a' and B′ b', emerge on the tracks $a'c$ and $b'c'$, as from a focus (virtual) at f'. Taking all the rays from the given point on the sun, inclined in the same degree as S A, s B (or rays between these), and S′ A′, s' B′ (or rays between these) to the line from that point to C, c, and c', we find a ring of foci, such as f and f'; (to avoid confusion, the ring is not shown as the ring $k\,k'$ is). In other words the point is transformed into a ring. But of course it would only be seen as a ring to an eye suitably placed on the axial line C c c'.) The case corresponds to that of the sun's centre supposed to be centrally behind the earth, in my former treatment of the problem.) Anywhere else within the region into which the rays are deflected, the point would be seen either as one point, or as two points on opposite sides of the sun. Thus to an eye at p, one point would be seen as at f close to the earth's edge, and no other; to a point at q one point would be seen as at f, slightly above the earth's surface, and no other; to an eye at p', where the rays $a\,c$, $b'\,c'$ cross, one point would be seen as at f close to the earth's edge, another as at f' slightly above the earth's surface, but no more. To an eye at c the point would be transformed into a focal ring close to the outline of the earth's disc; while to an eye at c' the point would also be transformed into a focal ring, but it would not be quite close to the earth's outline.

This we had already recognised (see my former papers) in another way.

The above explanation shows also in what degree the amount of light received from the sun will be diminished. For in whatever degree the already slightly divergent beam of light s B S A is made more divergent at its emergence in the form of the beam $b\,c'$ $a\,c$, its illuminating power for any surface exposed to it is correspondingly reduced. But since it may be shown that the apparent area of any small portion of the sun's surface is diminished when thus seen through our air, in precisely the same degree that the area-divergence* of the beams of light from it is increased, it follows that in this case as in all such cases, the intrinsic lustre of the surface is not affected except by absorption.

I incline to think that the fundamental error in Mr. Williams's inquiry into this matter has lain in the supposition that rays undergoing horizontal refraction at the surface of a sphere, that is falling on it tangentially or grazingly, pass in almost as grazingly as they enter, and then suffer total reflection. There is a passage in Brewster's "Optics" which I remember perplexed me very much when I read that work as a boy, in which he speaks of rays under certain conditions being totally reflected inside a sphere and afterwards undergoing repeated reflections and never getting out. I forget the actual wording; but I am inclined to think there was a real mistake on Brewster's part, not misunderstanding on mine. (The passage was only a casual remark.) Anyhow it is certain that no light which can get into a sphere of any substance can possibly suffer total reflection inside the sphere—for the simple reason that it can only get in at an angle not exceeding the critical angle, even if it falls tangentially; and at whatever angle it enters, at the same angle must it emerge.

* As distinguished from the linear divergence.

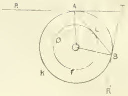


Fig. 5.

Thus if R A, Fig. 5, is a ray incident tangentially on the sphere A B K at A, refracted according to the law of sines* in direction A B, it will emerge tangentially at B in direction B R′. For, producing the tangents R A and R′ B to meet at T, it is obvious that the angle B A T is equal to the angle A B T′; and as B A T is the critical angle so also is A B T. The ray then which has got in, will get out again, along tangent B R′. Some light will of course be lost by reflection at B, just as some was lost at A. There always is reflection where there is refraction. But total reflection only occurs beyond the critical angle.

Thus we can always get light through the very edge of a sphere even of flint-glass or diamond. (Any one who doubts can get a sphere of diamond and try, forwarding to me afterwards as a present for pointing this out—a one-inch sphere will do very well). The experiment can be tried with a globular decanter full of water. (*This* need *not* be forwarded to me; but indeed that would follow at once from reflection. With a large globe, as a globular fish-bowl, the eye can even be so set that a distant luminous object—as the sun—would be altered into a ring by tangential refractions (an opaque body filling up the middle of the globe will prevent the direct image of the sun being seen at the same time, as it otherwise would; only the whole ring could not be seen at a single view, forming too large an optical field).

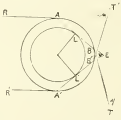


Fig. 6.

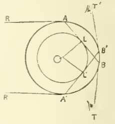


Fig. 7.

Figs. 6, 7, 8, 9 show the course of tangentially incident parallel rays: for water (refractive index 1·33), Fig. 6; glass with refractive index 1·5, Fig. 7; glass with refractive index 2 (very heavy flint-glass) Fig. 8; and air, supposed of uniform density, *in vacuo*, with refractive index (O A : O L) = 1·00028 Fig. 9, only A B ought to be much shorter, being really an arc of only 3° 10′.

An eye placed anywhere along B T in any of these cases will get light tangentially from B, in fact *see* the remote source of light (supposed to be far away on the left) in the direction T B. An eye anywhere along

* There is something to my mind rather clumsy in Brewster's way of dealing with refraction through a sphere. The little circles at incidence and emergence—as I remember them—introduce quite unnecessary complexity. Thus in the above case all we have to do is to describe a circle L D F with radius O L such, that ratio O A : O L = μ : 1 (μ being the refractive index) and to draw a chord A L B tangent to this circle: A B is the direction in which the ray R A is refracted, &c.

B′ T′ will see the object in the direction T′ B.′ In the case of a water-globe, an eye set at the place where B T, B′ T′ cross, would see the object converted into a ring of light all round the apparent edge of the sphere, if the angle B E B′ were not larger than the angular range of the optical field. (A fly's multiple eye set at E would so see the remote source of light.)

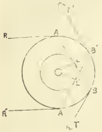


Fig. 8.

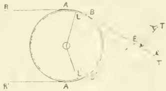


Fig. 9.*

Of course in the case illustrated by Fig. 9 an eye set where B T, B′ T′ intersects, would very conveniently see the remote source of light. This is akin to the case of the earth's atmosphere during a lunar eclipse, but the varying density of the air causes the region whence the sun can be wholly seen in ring form to be much larger than it otherwise would be: an eye set further away would see a ring image by higher layers—that is all.

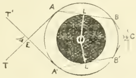


Fig. 10.

We may, however, even in the case of shells of glass—were it even flint glass—see a light turned into a ring in the way illustrated in Fig. 10—where C represents the flame of a candle, seen through a shell of crown glass by an eye at E. (A shell of crown glass must have a thickness equal to one-third the radius of the complete sphere.) For water—as anyone can in a minute try with a globular decanter full of water—the experiment is still more convenient. (Stand a rod upright in the bottle if you wish to prevent the direct image of the flame from being seen.) In this case, a shell as in Fig. 10 would require to have a thickness equal to one-fourth the radius of the sphere. But in all such cases the light comes tangentially from A and A′. [It is interesting to note that while a point of light may be thus changed into what looks like a very fine thread of light *at the very outskirts of the globe*, the rays by which the point is thus seen have approached the centre by a full fourth of the globe's radius.]

The mistake must not be made of regarding E in Fig. 6, or C in Fig. 10, as foci, for they have no focal character. Still less must one imagine E and C in Fig. 10 to be as conjugate foci to each other.

And now a word of explanation as to my reason for clearing up this whole subject till the last doubt or difficulty has been (as I trust) removed,—even at the risk of seeming censorious in regard to statements of opinion by my friend Mr. Mattieu Williams. On this particular subject, or rather on that part of it about which I have written here, I am well within my own ground. Mr. Williams was outside his, though not knowing it. There are many subjects in which, were I to venture, I should be on his ground and outside my own. It is very easy to fall into errors in so venturing, errors even which might be easily twisted so as to seem to imply ignorance in a grosser sense than mere want of knowledge. I will take as an example a mistake of my own—too silly for any use, as Americans would say—("I will [correct any error that I see, or seem to see, *but* I will] *rail* against no breather but myself, against whom I know most faults," all other railing, scoffing, and the like,—unless provoked by persistent conceit [or rudeness],—being to my mind hateful):—Dealing with hypothetical explosions of mixed oxygen and hydrogen in the sun, I said they would create an inrush, because the water formed would occupy much less space than the gases had occupied forgetting that it would be water in the form of steam, (that is, a vapour, not a liquid), which would really be formed—and though there would be, I believe, a diminution of volume, it would be nothing like what I had fondly imagined and carelessly suggested.

If readers, including Mr. Williams, will kindly understand that I have corrected him (and on a minor point my friend Mr. Ranyard) only as I wish others to correct me, or as, failing that, I will try to correct myself (only I always feel free to scoff a little at my own mistakes), they will not I think misjudge my discussion of the Ruddy Eclipsed Moon. They will see that if I have been *tena propositi*, I have wished at any rate to be *justus* also, just as I ought to be.* Possibly it may further serve the purpose of showing the spirit in which I strongly feel that all scientific inquiry should proceed.

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

XVIII.—CORSETS AND FEMALE FASHIONS.

THE evils of clothing having the character of bandages were referred to at the conclusion of my last paper. Such bandages not only interfere with the free and natural movements of the body, but in proportion to their impermeability they interfere with free transpiration from the skin. There is still another evil, long ago pointed out by Dr. Andrew Combe ("Physiology applied to Health and Education"). Speaking of female dress, he says, "From the tightness with which it is made to fit on the upper part of the body, not only is the insensible perspiration injudiciously and hurtfully confined, but that free play between the dress and the skin, which is so beneficial in gently stimulating the latter by friction at every movement of the body, is altogether prevented, so that the action of the cutaneous nerves and vessels, and consequently the heat generated, are rendered less than would result from the same dress more loosely worn. Every part and every function are thus linked so closely with the rest, that we can neither act wrongly as regards one organ without all suffering, nor act rightly without all sharing in the benefit."

I commend these wise words to the consideration of ladies who are considering whether or not they shall take the really very important step of discarding corsets and heavy hip-supported skirts. Their whole personal welfare, their capacity to enjoy life and perform its duties,

* In order to render Fig. 9 perfectly clear, the reader should draw straight lines A L B, A′ L′ B′, which were accidentally omitted in the drawing.

* But ought you to jest as here? *Printer's devil.*

and consequently their influence on others also, are concerned by reason of this inter-relation of the organic functions.

This brings me to the subject of stays and tight lacing. Many of my readers possibly expect that I shall reproduce the well-known picture of the Venus di Medici contrasted with that of a tight-laced cripple (a Venus *di Meretrice*), showing how the ribs are crushed in just where they should expand, and the consequent derangement of the thoracic and abdominal viscera; but I abstain from thus wasting my time or otherwise arguing against such practices, knowing well that the exceptionally few women who *now* deform themselves by such mechanical violence are below the reach of reason. Besides this, the suicide they perpetrate is beneficial to society; it promotes "the survival of the fittest." If such women lived to be mothers of families their like would be multiplied and occupy the places of the more worthy. If they only take rope enough—*i.e.*, pull hard enough at the staylaces—they will die early; if they pull not quite hard enough for this they may survive a little longer, get married, and die in childbirth; or a little less still, they may survive this ordeal, but have premature or stillborn children. No woman who is so devoured by insensate vanity as to deform herself by tight-lacing is fit to become a wife and a mother.

There is, however, another use more usually made of stays or corsets which stands quite apart from tight-lacing, and which still prevails among a large majority of the best of women, but which nevertheless is an unmitigated evil. I allude to the common practice of wearing stays as "a support."

A glance at the human skeleton shows that the internal abdominal organs, or viscera, are mainly supported by the basin-shaped expansion of the hip-bones—the pelvis—while the head and shoulders, the arms, and the bulk of the trunk are all held up by a comparatively slender stick of bone (the backbone), which, on further examination, is found to consist of twenty-four pieces, not rigidly attached by dovetailing or otherwise, but somewhat unstably united by intervening layers of flexible cartilage. Standing alone, it is not able to hold itself upright, but yields and bends over by its own weight if inclined in the least degree on either side. Added to this, it is curved considerably.

How, then, is it that man is able to maintain the erect position during life, and—if healthy—to do this so easily? It is by means of a system of muscles attached to the processes or projections of this back-bone. Some of these proceed directly from the processes to the edge of the pelvis, and act in a manner that has been justly compared to that of the shrouds and stays that hold the masts, and with them the sails of a ship, in their places in spite of the great overthrowing strain which a strong wind exerts upon the sails. Other muscles are variously arranged, forming the fleshy mass of the back, &c., and combine, with the above-named, not only to stay but at the same time, by their alternate contractions and extensions, to execute the movements of the body.

These muscles, like those of the limbs, require daily regular exercise, in order that they may retain their normal healthy amount of energy or power. This exercise must consist of their full contraction and extension.

It must be evident to any intelligent woman that if she surrounds her body with a closely-fitting scaffolding of whalebone and steel-busks, or any similar scaffolding or stiff bandage, the free action, the healthy exercise of the muscles concerned in the support and flexure of the body must be impeded in proportion to the rigidity of such bandage. If the right arm were similarly bandaged and its muscles similarly restrained it would soon become weaker than the left—almost useless in fact; if the legs were similarly treated the victim would, in the course of time, become unable to walk a single mile.

Thus it is that the practice of wearing stays, commenced in girlhood, merely in blind obedience to custom (forwarded in many cases by the girl's desire to be womanlike, as little boys smoke pipes and cigarettes to appear manly) produces the weakness that in after life creates the demand for their continuance. The case is just analogons to that of snuff taking, smoking, and other bad habits, which create a special weakness temporarily relieved and permanently exaggerated by their continuance. The snuff-taker, when deprived of his box, is miserably depressed. Had he never began snuff-taking he would suffer no such depression. The stay-wearer when deprived of her stays feels miserably weak and flaccid. Had she never worn stays she would suffer no such misery.

The remedy is the same in both cases. Resolution is demanded; the consequences of the vice must be endured for awhile, until the artificially weakened organs recover their healthy tone. I am told by emancipated ladies that they found the struggle much less severe than they had anticipated. This will probably be found in all cases where the abandonment of stays is accompanied with the adoption of divided underskirts of far less weight than the ordinary strata, and with the other suitable under-clothing now so well understood by dress reformers.

I must not leave this part of the subject without a word in recommendation of those admirable knitted body garments known as "Cardigan jackets." Made of pure wool, they combine nearly all the qualities demanded theoretically in ideally perfect clothing. During a recent visit to Scotland, I was much pleased to see they are still worn there by school-girls and sensible women as commonly as when I lived there more than thirty years ago. The school-girls then knitted them for themselves. I hope they continue to do so.

They are suitable for men as well as for women. The only objection I have heard against them as men's garments is that they are worn by barmen and pot-boys. This may have some force in the case of men whose social position is doubtful, and whose avocation might, therefore, be mistaken. But even in their case there is a remedy. Let them wear Cardigan jackets made with visible outside pockets. The barman wears a knitted overall jacket without pockets, and tight at the wrists, as a protection to his employer's till.

This is my last paper on this subject, and it may suitably conclude with a few remarks on the moral philosophy of clothing, especially of women's clothing. As they devote so large a proportion of their moral energies so much thought and earnest feeling, to the subject, and this from an early age, its educating influence on the formation of their character must be considerable; and their conduct in reference to this subject may be fairly regarded as a prominent indication of character.

What, then, must be our verdict if we analyse this influence, and apply this test for the determination of whether the intellectnal conclusions and practical conduct of women generally are or are not based upon fixed intellectual and moral principles.

What are the principles, are there any principles, or any idea of principles, or respect for principle, regulating the mind and conduct of women (I mean average, not exceptional, women) in the very engrossing business of the selection and general conduct of dress?

I am unable to find any beyond that of a blind obedience to some invisible, absolutely occult, dictatorship of fashion. The question is not what is desirable to wear, on either sanitary, economical, or artistic grounds, but simply what *is* worn, or what is likely to be worn presently. It is not merely a game of follow my leader, but the following of an absolutely unknown leader. Who is the dictator or designer of those caricatures that appear in the fashion-books, the ladies' newspapers, &c.? It is an invisible, unknown ring of millinery traders, whose business is simply to lead their victims on from one absurdity to another, never allowing any to be permanent, lest the poor sheep should fail to be fleeced at each succeeding season by continuing to wear the dresses or bonnets of the last season.

These fluctuations are void of the slightest basis or pretensions to a basis of personal convenience, good taste, reason, or any other element capable of alleviating their absurdity. One day it is decreed that the elegance of a skirt is proportionate to its circumference and outward projection, and complex machinery of iron hooping is invented to distend it. So long as the fetish of fashion maintains this decree its worshippers are compelled to admire the abomination, and actually pervert their natural sense of beauty sufficiently to do so. Presently the invisible Moloch orders that skirts shall be narrowed, shall be limp and clinging to the legs, shall be extended behind in hideous humps and trails. Then these become admired, and the proprietor of a dozen yards of humps and draggle of costly material is envied by her poorer sisters who cannot afford to stir up the dust or sweep the mud with more than two or three yards. The "duck of a bonnet" of to-day is the vulgar "fright" of next season, and not the smallest approach to any rational excuse can be pleaded for the change of taste. It is simply morbid. What a chaos of contradictions must infest and stultify the intellect of women who are subjected to this continuous training in inconsistency!

Besides this undermining of the judgment there is the degrading bondage of ever following the folly of the foolish, and never daring to act independently.

Nobody can desire more earnestly than I do to see the views of John Stuart Mill concerning female suffrage carried out; but I dare not advocate their adoption, fearing that women's ideas of political propriety will be as changeable as their notions of personal elegance, and that if they had votes invisible political wire-pullers would enslave them for their trading purposes as effectually as milliners, dressmakers, hair-dressers, boot-heel makers, &c., at present succeed in torturing and degrading them. If they have not sufficient moral and intellectual independence to enable them to select a convenient and becoming style of dress, and having chosen it to adhere to it, are they likely to use their own independent judgment in the selection of members of Parliament? If they have no approach to fixed principles for the guidance of their taste, are they likely to have any principles for the government of their politics?

If they continue to deform their heads and sprain their ankles at the dictation of Parisian milliners, are we not justified in fearing that they may follow the fluctuations of Parisian politics, or bow down to some other analogous dictatorship. It would be fatal to the nation if an important proportion of the constituency were capable of being led blindly, submissively, and unthinkingly by an outside interested dictatorship, such as that which governs the senseless fluctuations of fashion in female dress and so easily enslaves the whole sex.

Let not the gentlest of my "gentle readers" misunderstand me; I am not railing against pretty dresses, pretty bonnets, pretty ribbons, or any other really pretty decorations for pretty women—and all women are pretty, more or less. On the contrary, I maintain that beauty being one of the natural attributes of woman, she is bound to cherish and cultivate it most religiously. Due and proper attention to dress is one of the domestic duties of all women, especially of married women. The wife who neglects her home dress fails in one of her duties to her husband. But such dress should be designed in accordance with the *fixed* principles of good taste and suitability to occupations and means. The cheapest dress of the poorest woman may be tasteful and elegant; the dress of the kitchen, of the nursery, or the drawing-room may all have these attributes combined with suitability. But the fulfilment of these conditions of good taste is obviously impossible if the pattern of dress is compulsorily changed from season to season in obedience to mere caprice, void of any element of that progressive improvement which alone should be the motive of every change.

PIONEER PASSENGER RAILWAY.

FIFTY-FIVE years have elapsed since the opening of what may be regarded as the first passenger railway ever constructed in this or any other country. Although the Stockton and Darlington line was the first railway ever constructed in England, having been opened on September 27, 1825, it was primarily intended and used for the transit of coal, lime, and bricks from the interior to the seaboard. It is true that, in the following month, a passenger coach was placed on the line, drawn by one horse, and performing one journey daily between the two towns, travelling at the rate of about nine miles an hour. The waggons containing coal and other merchandise were drawn by a locomotive built by George Stephenson, the maximum speed being from ten to twelve miles an hour. The 15th of September, 1830, will therefore be remembered, for all time, as the day on which travelling by steam-power on a large scale was inaugurated, in the opening of the Liverpool and Manchester Railway, where the complete success of the locomotive steam-engine was accomplished; the "Northumbrian" engine, on that occasion, with the Duke of Wellington and other distinguished visitors in the train, attaining a speed of thirty-six miles an hour. Following upon the opening of the Liverpool and Manchester line, the construction of railways in different parts of the country rapidly succeeded each other, and it is interesting to look at what has been accomplished in this branch of engineering during the last half-century, not only as regards our own country, but also in Europe and other foreign regions. Confining our notice to the United Kingdom, we find, according to the last official return, brought down to the close of the year 1884, that the authorised capital in respect of the lines now opened for traffic was, at that period, £742,417,327, and the aggregate length of railways 17,512 miles, which will shortly be still further increased by the completion of the several new lines now in course of construction. The total outlay in the construction of the lines now open, down to the end of last year, was £628,276,016, and the estimated further expenditure during the present year is upwards of £12,000,000. What may be classed as the fifteen leading lines, which have from time to time absorbed so many

of the smaller railways into their respective systems, represent £644,246,356 of the total capital of the various lines open, leaving £78,718,559 as the capital of the remaining lesser lines. The fifteen leading lines, as above named, have an aggregate length of 13,475 miles, an analysis showing that, as respects mileage, the Great Western Company stands at the head, while the London and North-Western Company has the largest amount of capital, being £101,771,907, with a mileage 1,794 miles in length. As regards capital, the Midland Company is next in amount, with £76,549,267, and 1,270 miles of railway. The capital of the Great Western Company is £75,108,424, and its length of railway 2,301 miles. Then follow the North-Eastern, with a capital of £57,650,895, and 1,536 miles of railway; the Great Eastern, capital £41,087,103, and 919 miles of railway; the Caledonian, capital £36,324,700, and 772 miles; the Great Northern, capital £35,380,050, and 949 miles; Lancashire and Yorkshire, capital £41,852,949, and 496 miles; North British, capital £33,576,211, and 984 miles; Manchester, Sheffield, and Lincolnshire, capital £27,248,627, and 291 miles; London, Chatham, and Dover, capital £25,634,008, and 176 miles; London and Brighton, capital £23,768,899, and 455 miles; South-Eastern, capital £21,915,824, and 385 miles; London and South-Western, capital £29,455,931, and 818 miles; and Glasgow and South-Western, capital £13,921,570, and 330 miles.—*The Times.*

NITRIFICATION.

By E. W. Prevost, Ph.D.

THERE are several questions which are frequently asked by an inquiring person possessing scientific proclivities; whenever he sees or hears of natural phenomena which have not been explained to him, but which he thinks are capable of explanation, he launches out with "How does that happen?" "What makes it do that?" But such questions as these are most generally asked of phenomena occurring above ground, or if asked of anything taking place below ground, it is usually in connection with something more or less visible; as, for example, the inquirer is aware that after a grain of wheat is sown, it will sprout and grow; his questions are therefore directed to the cause of its sprouting, and the food of the future plant, &c. But concerning that which to the general observer is invisible there is but little curiosity evinced, and it is to one of these invisible phenomena that I now wish to direct the reader's attention, for although the phenomena referred to has been known for many years past, yet it is only quite recently that the true explanation has been forthcoming.

I have in previous articles referred to those constituents of the soil on which the plant, when growing, feeds; and I also showed that all the food derived from the soil must be in a state of solution. My object now is to direct special attention to the very important food, nitrogen, which exists in at least two forms of combination, both of which are soluble in water, but one is of use to and is absorbed by the plants, whilst the other must be converted into the first, otherwise it is of no use. For the first form nitrogen is combined with oxygen, and exists as nitric acid combined with lime (calcium nitrate), and in general it is spoken of as the "nitric acid" in the soil; the second appears as a compound of ammonia, where the nitrogen is combined with hydrogen, and it is, I repeat, in this form that nitrogen is not acceptable to plants, though it is soluble with ease in water. Now no large quantity of "nitric acid" (nitrates) exists in any soil, because the demand on the stock is heavy, the supply being barely sufficient to keep up the stock; there is also a further reason for this deficiency, and that is to be found in the very solubility of the salt itself, and the incapability of the earth to retain nitrates, as it does most other compounds; the consequence of all this is, that much of the most valuable material is to be found constantly, and at all times of the year, but more especially during wet, wintry weather, in the drainage waters. Whence, then, comes this nitric acid, which, if there were not an unfailing and continuous source, would so soon be absent from our soils? The knowledge that compounds of ammonia may be converted into nitric acid—that, under certain conditions, oxygen may replace hydrogen—is not of very recent date, but the cause of this conversion in the soil has been ascertained only during the last few years.

It was not until 1877 that Schlösing and Müntz showed that this process of conversion, now called nitrification, was due to an organised ferment, and our more extended information is very largely due to Mr. Warington, at Rothamsted. It would occupy a far greater space than the editor can spare to describe fully all the results which Mr. Warington has obtained, so that it must suffice to state in as few words as possible the chief points. That the ferment shall grow it is necessary that nitrogen in some form other than that of nitrates be present. The process is slow at 0° C. (32° F.), increases as the temperature rises up to 35° C. (91° F.), at which point the action is at its maximum, after which it decreases until 55° C. (131° F.) is reached, when it ceases altogether. Like all other ferments, antiseptics are fatal to its action. The nitrogen in sewage or soil heated to the boiling-point of water will no longer be converted into nitric acid as the ferment is killed, but if some fresh soil be introduced into the sterilised liquid, then nitrification recommences. Knowing now these the chief points in the discovery, let us see what effect the conditions under which nitrification proceeds has upon the soil in a field. Taking it, therefore, that we have abundant proof that it is to the nitrogenous compounds in the soil that we have to look for the supply of nitrates, are we to believe that nitrification proceeds actively all the year round, when in winter the plants hardly grow and require but very little nitrogen, and when great loss would occur through the heavy rains and melting snow washing away valuable material? No, certainly not; for the ferment decreases in activity as the temperature falls, so that when the ground is frozen there is no formation of nitric acid; in the lower stratum of soil, when the temperature has not fallen below 0° C., there is, of course, some nitric acid being produced. Part of this may be absorbed by roots of the crop in the land, whilst the rest will most probably be lost.

Being acquainted as we are, and as I have pointed out in a previous article, with the valuable changes taking place in the soil during winter and summer, we are now more able to appreciate one of the disadvantages of permitting a field to lie fallow—*i.e.*, to carry no crop during winter and summer. I do not wish to argue that fields should not lie fallow, for there are very many benefits derived from such a state of affairs, but I am anxious to point out clearly that there is a loss incurred. In the summer the temperature is high, and consequent active nitrification takes place; but as there is no crop to take

up the nitric acid, the first rains wash it all away; then, again, all the winter through, if it is mild and wet, there is a constant loss, which is reduced when the weather hardens, and the ground temperature falls to 0° C. The natural remedy is always to keep something growing on the land; but this is not advisable on some classes of soil; and as other and great benefits accrue from a bare fallow, the advantages may, perhaps, more than balance the disadvantages; more than this I shall not say, as I might enter within the bounds of a controversy unacceptable to the readers of Knowledge.

EARTHQUAKE REGIONS.

By Richard A. Proctor.

Earthquakes occur in all regions adjacent to active volcanoes. Thus the neighbourhood of Vesuvius, Etna, and Teneriffe is infested by subterranean convulsions, which also are frequent over the neighbourhood of the Greek Archipelago, and in Syria. In fact it seems probable that the whole of the Mediterranean basin and the surrounding lands for a distance of many miles from its shores form a single earthquake district, whereof Teneriffe, Vesuvius, Etna, Stromboli, the Archipelagic and the Syrian volcanoes are the safety-valves. Then there is another earthquake region surrounding Hecla or—some say—extending in a long line from the Jan Mayen volcano, through Hecla, the Azores, and the Cape Verde Islands, to St. Helena and Tristan d'Acunha. Japan, Sumatra, Java, and the islands of the East Indian Archipelago are liable to fearful earthquakes,—some of the most destructive of which have occurred within the past few years. In the West Indies there is another earthquake region, to which must be referred those which have recently taken place. Probably this district belongs to the great earthquake region in Columbia and Peru, around the celebrated volcanoes Cotopaxi and Chimborazo. The south-western district of the United States is also liable to earthquake shocks, apparently referable to the great Mexican volcanoes. There is one region of the earth in which subterranean shocks occur which cannot be referred to the neighbourhood of volcanic vents. Upper India and parts of Western India are liable to frequent earthquakes, insomuch that between the years 1800 and 1842 no less than 162 earthquakes were recorded in these places. Undoubtedly we may trace these disturbances to the great mountain chains which traverse this part of Asia. The subterranean forces which upheaved the great Himalayan range, for instance, may be assumed to be still existent, though now for a while dormant, or "perhaps," says Sir John Herschel, "expended in maintaining the Himalayas at their present elevation."

On the other hand there are some regions wholly free from earthquake shocks. Among such may be mentioned the great alluvial plains of America east of the Andes, the plains on the north-east of Europe, and the northern parts of Asia. There are monuments, natural and artificial, which prove the absolute fixity of some regions. The slightest shock would have flung down that strange mass which is perched upon the summit of the Peter Botte mountain, 1,500 feet above the sea-level. Pompey's Pillar justifies the assertion of Strabo that Egypt has long been free from earthquakes; though nothing short of subterranean convulsion could have flung down the more ancient obelisks which lie prostrate amidst the sands of Western Lower Egypt. Even that masterpiece of Egyptian labour, the Great Pyramid, though surpassing all other human erections in stability, shows unmistakable evidence of the slow action of subterranean forces*. In Mexico, again, in the very centre seemingly of earth-rocking forces, there is a region in which rocks of grotesque figure attest the perfect immunity which the region has enjoyed even from inconsiderable shocks. The Cheese-ring in Devonshire is another instance of the kind of evidence we are considering.

And as there are instances of regions near to a disturbed district which yet are free from shocks, so there are spots liable to frequent shocks though the neighbouring country for miles on every side is seldom (if ever) disturbed. Such is the district—very limited in extent—near Comrie, in Perth, where a year scarcely ever passes without a shock being experienced.

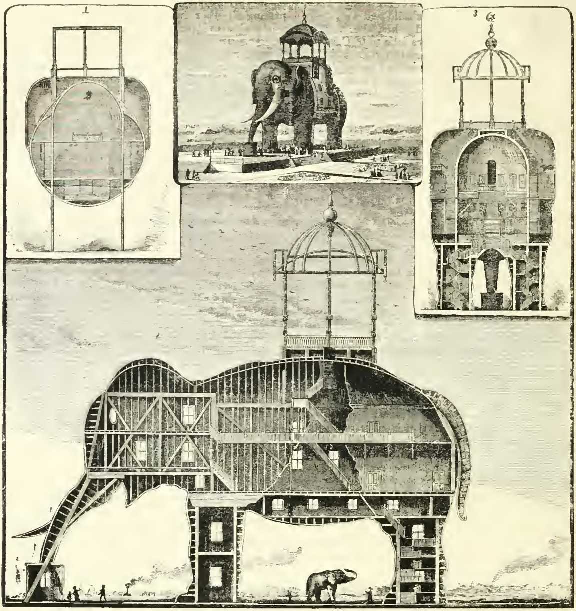
It would seem also as if regions free from subterranean disturbance for many centuries must not count upon permanent immunity. For a violent earthquake will often open out, as it were, a passage for subterranean impulses to new regions. "The circles of concussion enlarge," says Humboldt, "in consequence of a single extremely violent shock." Since Cumana was destroyed (December 14, 1797) every shock of the southern coast is felt in the peninsula of Maniguarez, which before suffered no disturbance. Again, in the successive earthquakes which traversed (in 1811-13) the valley of the Mississippi, Arkansas, and Ohio rivers, it was noteworthy how the motion travelled farther and farther northward on each occasion. It seemed as if the subterranean forces were gradually breaking a way through successive barriers.

THE COLOSSAL ELEPHANT OF CONEY ISLAND.†

The reputation that the American people have long had of always doing everything on the grandest possible scale has lately received a very substantial confirmation in the two monuments that have recently been bestowed upon this country. The Washington Monument and the statue of Liberty are the greatest works of art in height and magnitude that have been raised by the hands of man since the Tower of Babel. In addition to these there is a third monument, facetiously styled the eighth wonder of the world, that has recently been raised in the neighbourhood of New York, that for one reason deserves to be named in the same connection with the foregoing—namely, on account of its size. The Colossal Elephant at Coney Island has not been favoured with much serious public attention, owing to the fact principally that it is not an artistic work, and, secondly, because it is the project and property of a stock company, whose unexalted aim was to rear a structure that would serve, not so much to elevate the public mind artistically, nor to stand as a monument to some of our noted forefathers, but rather to abstract the unwary dime from the inquisitive sightseer. This fact, and the grotesque nature and enormous size of the colossus, has deprived it, up to this time, of much consideration, but this should not deter us from inquiring how a building of such unique design and original construction was called into being.

* "The quantity of the post-pyramid *tilt*," says Professor Piazzi Smyth, "appears to be about thirty-seven seconds," as given by the corner angles of the Great Pyramid.

† From the *Scientific American*.



The Colossal Elephant of Coney Island.

It was designed and built under the personal supervision of the architect, Mr. J. Mason Kirby, of Atlantic City, New Jersey. It was first intended to make it an hotel, but later this idea was abandoned, and it was decided to construct the interior with the purpose of using it as an auditorium for concerts, &c., while the platform on the top, or the howdah, as it is termed, would serve as an observatory. The elephant is constructed of wood throughout, and is covered with sheet-tin. The total length from the trunk to the back part of the hind legs is 150 ft. The platform of the howdah is 88 ft. from the ground, and the total height to top of crescent on flag-pole is 150 ft. The height from ground to body, when standing immediately underneath, is 24 ft. The legs are 18 ft. in diameter, and the two hind legs are provided with circular stairways leading to and from the rooms above.

The first room reached in passing up the stairs is termed the stomach-room, and is dignified with this title, not because it is provided with the wherewithal to cheer the inner man, but owing to its special location in the body of the beast. The different rooms in the animal are likewise christened after their particular location, as the thigh-room, brain-room, hip-room, &c. The grand hall, or auditorium, is reached upon ascending the stairs, and this is found to be very spacious and airy, the ceiling being very high and slightly dome-shaped. A gallery passes all round the hall. At the further end of it a flight of steps lead to what forms, in fact, a continuation of the main hall, only on a higher plane. The main hall is 80 ft. long and 32 ft. wide, while the upper part of the main hall is 36 ft. long and triangular in shape. There are thirty-four rooms in the structure in all, which are located principally between the walls of the hall and the outer walls of the structure. Most of them are quite small, and are very extraordinary in shape, their walls conforming to the shape withou of that particular section of the colossus. The eyes

which form the windows of two of these rooms, are 4 ft. in diameter. The tusks are 36 ft. long and 5 ft. 8 in. in diameter.

In laying the foundation of the structure the builders met with some difficulty, owing to the instability of the soil, it being simply a sandy beach. Piles were driven to a great depth, and a solid platform was raised on top of the piles and secured firmly thereon. A second platform, which was designed to bear the direct weight of the colossus, was constructed above this, and was supported on vertical timbers strengthened by inclined braces reaching to the platform, with a view of resisting great lateral as well as vertical strains.

After the foundations were completed, work was commenced upon the visible portion of the building, the legs being the first point of attack. Yellow pine posts, 12 by 16 inches, were first raised above the platform, and, being bolted to the flooring beneath, were made self-supporting. Two posts, 42 ft. long, were thus raised in each leg, and twelve smaller timbers, placed in a circle so as to inclose the main posts, were also bolted to the platform in a similar manner to form the outer wall of the leg. These timbers were joined at the top by connecting beams.

Cranes were mounted on the platforms thus formed, to which the material was raised as the work progressed. The difficulties increased, however, with the work, and it became necessary to secure the services of the most skilled workmen. Not only was this so on account of the dizzy height that the structure attained, but to the necessity of conforming the construction to the peculiar emergencies that arose, it being requisite to form nearly all the parts on the spot, under the immediate personal supervision of the architect. The weight of the structure is carried, as may be seen by the engraving, by five supports, the four legs and the trunk.

Commencing at what is now the flooring of the main hall, trusses were raised on each side and at the two ends of the hall, and these trusses (the bottom chords corresponding with the floor and the top chords with the ceiling of the hall) constitute the principal support of the ribs. It will be seen from this that what might be termed an immense box girder was formed, the ends of which are supported by the front and hind legs respectively.

The ribs weigh directly upon the upper chords at the four corners, but at other points the ribs bear away from the chords, owing to the enlargement of the body under the howdah. At these points it was necessary to extend the vertical and horizontal members of each truss from the wall and ceiling until they intersected with ribs. In addition to this, an arched rib, corresponding to the backbone, is carried from the main support of the hind legs to the neck of the monster, where it bears indirectly upon the vertical support of the front legs. The ribs in the body of the colossus are forty in number, and each consists of six sections bolted firmly together. As they serve to give consistency and rigidity to the whole structure, they form an important element in its construction. They are about 7 in. in width, and are placed 2 ft. apart, measuring from centre to centre. The head framing is similar in general construction to that of the body, and is supported by the trunk and forward supports of the front legs. It is provided with twelve ribs. Great difficulty was experienced in raising the ears and adjusting them in position in the head. This was principally due to their enormous weight—some six tons each—and the great height to which they had to be raised, and the difficulty of securing such an enormous mass securely to the drums which had been prepared to receive them in each side of the head. In addition to being bolted firmly in position at these points, iron rods were extended from the main trusses within through the ears at two points below the drum. The ears are some 34 ft. long by 20 ft. wide.

The architect depends upon the enormous weight of the elephant, and upon iron rods that pass from the trusses above, through the legs, and connect with the foundation platform, to hold the colossus in its position. He has kindly furnished us with a few statistics that may be of interest. The colossus, he informs us, weighs about 100,000 tons. It contains 1,500,000 square feet of timber, and 700 kegs of nails were consumed in its construction. In addition to this, 7 tons of bolts were disposed of, and it required 35,000 square feet of tin to cover its surface. In size it compares favourably with many of the large hotels and other structures in its neighbourhood; and some idea of its magnitude may be had by comparing it with Jumbo, which is drawn in scale by its side, and which would find plenty of room for a promenade within one of the legs of the colossus.

RATIONAL DRESS.

We quote the following interesting paragraphs from the reports of the Rational Dress Society:—

Miss Sharman Crawford, a member of the Committee, who passed last winter in America, brings an encouraging report of the interest taken there in dress reform.

For the present, however, the reform in that country is almost exclusively limited to underclothing, in which department boneless bodices as a substitute for corsets are a conspicuous feature. The weight of the fashionable skirt is generally deplored, but the contumely to which ladies who adopted the Bloomer dress were subjected impelled many to submit unwillingly, as the lesser evil, to the dresses of the prevailing *mode*, and by these the divided skirt has been welcomed as affording in a considerable degree a solution of the perplexing problem of the reconciliation of personal comfort and public approval.

In San Francisco, where Miss Sharman Crawford gave a drawing-room lecture on the subject of Dress Reform, an urgent request for patterns of the divided skirt she wore was made by the ladies present. In Boston, too, she found the divided skirt regarded with much favour, and there also the patterns of the dress were much solicited.

In America the prevalence of rational ideas in reference to shoes was also clearly shown by printed labels bearing the inscription "Common Sense Heels" frequently seen in the windows of shoemakers' shops.

In California several ladies accustomed to riding constantly complained of the unnecessary fatigue to which they were subjected by the use of the side-saddle, and several said that on mountain excursions in the summer-time they frequently rode with ordinary saddles, adopting for the occasion a kind of Bloomer costume. Not only did this departure from conventional rule give them increased security and relief from the cramping effects due to a constrained position for several consecutive hours, but their horses derived great benefit from the removal of that unequal pressure which so often renders the side-saddle an instrument of torture to animals.

So serious has been the injury inflicted on horses by side-saddles, that in one town in California a livery stable-

keeper refused to supply ladies with any horses for riding. From her own experience during an Algerian riding-tour, Miss Sharman Crawford confirmed the disabling effects of side-saddles on horses, and also the personal benefit derived from adopting a more natural position.

The Committee desire to call the special attention of the Society to this point, and to the dependence of "rational riding" upon reform of a "rational" kind in dress.

Miss Sharman Crawford reports that a curious instance of tyranny and intolerance in regard to feminine attire occurred lately in America. Some ladies in a town in the State of Montana, adopted for outdoor wear a long, loose gown ungirt around the waist, somewhat resembling the Mother Hubbard Mantle. Not only were the wearers of the dress hooted in the streets, but, in deference to public opinion, which affirmed that purity of morals was incompatible with such looseness of attire, the objectionable innovation was *suppressed by municipal decree.* The newspapers which announced the fact found no fault with the Mayor's action, nor did any editor seem to find anything ludicrous in the inference to be drawn; namely, that tight-fitting jackets were henceforth legally recognised as the visible evidence of high principles and moral worth. The attention of the Mayor of Philadelphia was likewise called to the fact that ladies in his municipality were wearing the Mother Hubbard costume. His worship was, however, of opinion that the matter did not necessitate an official decree!

The English press still continues to discuss the subject of dress reform with unflagging interest, and as all the Rational Dress Society's members may not have seen the articles which have appeared in various papers on the question, your committee append a few extracts from letters, &c., recently published, which will probably interest the champions of Reform.

In comment on an article which appeared in the *Daily News* disparaging the artists of the present day, a member of the Rational Dress Society writes as follows to the editor of the *Daily News*:—"Sir,—Is not your brightly-written leader on our unsuccessful artists a little hard on them? In one way, at all events, they have fallen upon evil days. The costume of their time is contemptible. The streets should be their schools—would have been so in Florence, in Venice, in the Low Countries, in times past. The artist had but then to draw fairly well a figure as he saw it, and behold a picture! For costume was then picturesque. If, however, he only drew faithfully what I saw a few days ago in Mayfair, he would pourtray a young girl who, between padding in some places and pinching-in in others, had come to resemble a stuffed pincushion. She could not walk. She literally tottered, owing to her pointed-toed and high-heeled shoes, her severe lacing, and cumbersome skirts. Think of the difference between sitters who came to Vandyke, and those, though they be their lineal descendants, who sit for their portraits to day! . . . . I will try to make a faithful picture in words of a lady, an earnest devotee of fashion, one who is a type of many women, and I ask you what inspiration can a painter draw from her and others of her kind? Her waist, which is down among her digestive organs—or physiology lies—measures seventeen, or at most eighteen inches; whereas the waist of the little Medician Venus is twenty-six . . . . She wears a crinolette or dress-improver, looking like what is known in architecture as a flying buttress. I involuntarily shudder lest she may snap at the narrowest point, but she does not, she does not even make moan . . . . She knows she is in the fashion, 'Il faut souffrir pour être,' not 'belle,' for no one with an eye for the beautiful could call her so, but 'à la mode.' Perhaps a painter of sardonic humour might give her grotesque outline a place in a new 'Dance of Death' . . . . But what is there in her to gratify the artist's eye? Beauty of form? Rather deformity. Flowing drapery? Oh, no, nothing but the solid edification of that wretched flying buttress. Grace of motion? Not so much as is possible to a Dutch doll! Could Giotto have invented his lovely 'dancing girls' had he looked on the costumes in London in this year of grace 1885? Where would even Guido's 'Hours' have been under such unhappy sartorial circumstances as ours? Is there not some excuse for our unsuccessful artists?"

A correspondent of the *Pall Mall Gazette*, in a letter headed "Ladies' Dress, Æsthetic and Artistic," says:—"If we can teach the right principles that underlie all good forms of dress, that is as much as we can aim at. Taste is an individual possession, and as rare as any other artistic gift. What above all things we desire is to preserve the proper proportions of the human figure while allowing as much freedom and ease of motion as possible . . . . Being much interested in the efforts of the promoters of the Rational Dress movement I should like to add that the inconvenience of their dress is owing, not to its eccentricity, but to the necessity they are under of trying to make the divided skirt look as though it were *not* divided, on account of the intolerance of the British public. I trust the time will not be long before we may be allowed to wear a walking dress that is at once useful, comfortable, and artistic."

In an article in the *Pall Mall Gazette* of May 21st, a member of the Rational Dress Society writes as follows:—"We of the Rational Dress Society look down as from a proud eminence on those writers who have been pleading in your columns for frills *versus* furbelows, and puffs *versus* no puffs. As much misapprehension exists with regard to the costume of the Rational Dress Society, and especially respecting the dual skirt, I wish to describe it with what may be even wearisome minuteness. The skirt is by no means the only reform we advocate, but it is the only thing in our programme which is a departure from received notions. The skirt should quite clear the ground. Each half of the dual skirt should be a yard or three quarters of a yard at the ankle. Our Society recommends that the skirt and the underclothing be fastened to a broad band fitting round the hips, so avoiding pressure of any sort round the waist, or, if preferred, hooks or buttons can be sewn on a bodice to correspond with buttonholes on the skirt. If the weight of the skirts be hung from the waist, and not supported, as reason would dictate, by the bony framework of the body, it causes displacement of internal organs. For the top part of the dress, our Society favours any loose body or jacket, but forbids bands, ligatures, or pressure of any sort, from below the fixed ribs to the top of the hips. In our costume, the weight of clothing is minimised, because the dual skirts clothe the body fully and evenly, fewer garments are needed, and each garment is of a simpler form, requiring much less stuff to make it. We are far from saying that our costume is absolute perfection, but we maintain that we have devised a dress by which no internal organ can be injured, no muscle cramped, no movement of the body impeded, and to which the wearer may add as much grace and beauty as her own good taste may suggest."

Gossip.

By Richard A. Proctor.

The arrangements described in last week's "Gossip" will be carried out in the first monthly number of Knowledge. Mr. Jerome Harrison is preparing a paper on the "Geology of London," and Mr. Butler one on an insect of attractive household character. Mr. Slack will not I know desert us; and though his subjects are microscopical, their interest is quite otherwise. As several readers have at sundry times asked me to introduce into the pages of Knowledge a portrait of the Conductor of that widely-read paper, I have thought that the first number of the new series would be a suitable opportunity. So many engravings (sometimes from the same photograph) have presented me in aspects ranging from the utterly ferocious to the sweetly sniggering, that I have thought (not knowing which of these is right, or if any of them can be) that a Luxotype reproduction from a photograph in Messrs. Elliott & Fry's "Gallery" (which they have kindly given me leave to use for this purpose) would probably be more correct. I imagine, however, that my work is a better portraiture of all that readers care to know of me than any picture.

And by the way, now that I am taking leave of the work I have done in the column of "Replies," I may remind readers who—not having themselves asked questions—have read my answers there, that they are not to suppose I am in reality the bear I might seem to be from *some* of my answers, judged without sight of the letters addressed to me. Our lively but often wrong "Hallyards" tells me for instance that he has often *winced* at the answers I have given to others. He should have seen what brought forth those answers.

As a curious illustration of the amenities of some of those who address me, I received a few days since a letter assuring me (in effect) that I am,

(i) a liar, (ii) a hypocrite, (iii) a bungler,
(iv) a sophist, (v) a savage, (vi) a bear,
(vii) an idiot, (viii) an ignoramus, (ix) an Antinomian,

(or *not* an Antinomian, I forget which: it was meant for abuse whatever it was). All this is in the compass of four sides of letter-paper—the writing being as wide as the charges were broad. Can the general reader wonder if replies are occasionally pointed, when attacks are so bludgeonly? (I beg leave to patent this word.)

A correspondent wrote me a letter some time since signed "*Quo usque tandem,*" to which I began a reply continuing the quotation *abutere patientia nostra*, then changed my mind, and inserted "It would be," altering (or intending to alter) the Latin into *Abuti patientia lectorum nostrorum.* Whether I carried out the alteration fully or not I cannot well remember; but the passage appeared in this remarkable form,—"It would be *abutere patientiam,*" &c.! On this "Hallyards" and one or two others rejoicingly pounce on me with the jeer that this man who sits on our science thinks *abutere* is infinitive, ho ho! and that it governs a noun in the accusative, ha ha! (likewise hau, he, how, hi, haw!) "Hallyards" insists that "being an experienced examiner," he *knows* I thought thus. Imagine, or admit as unimaginable, the state of a man's mind who could suggest the bare possibility that, in the well-known passage which every schoolboy (except Macaulay's) knows by heart, the verb in the familiar six-words *question* could possibly be in the infinitive! * Then when I point out (to "Hallyards") that, however obvious this utter absurdity may seem to him, I at any rate did not make the mistake (*tanquam referret*), he replies that evidently editors are not called on, like other persons, to speak the truth!

But then he adds that I am "the second person he ever felt enthusiastic about," which sounds nice,—though whether enthusiastic for or against, the deponent sayeth not.

Now it is a matter of small moment to me that "Hallyards" or anyone else should abuse my Latinity, which is of a very mixed kind. (I read Latin and Greek easily, but I could not analyse a sentence worth a cent.) To give me the lie, though, when I *know* (much more certainly than "Hallyards" even imagines he knows) that I have carefully spoken the truth, *c'est par trop fort.* Yet it is "Hallyards"—believe it if you can!—who "winces" when he sees me laying on the thong. No one ought to know better than he does what occasion there has sometimes been for it.

However, I am glad to lay down an office of the most ungrateful sort and by no means congenial to me. Hereafter I appear in these pages, as I do on the platform, to reason and to study, not to argue.

Reviews.

SOME BOOKS ON OUR TABLE.

Our Insect Enemies. By Theodore Wood. (London: Society for Promoting Christian Knowledge. 1885.)—We spoke highly on a former occasion of Mr. Wood's work, "Our Insect Allies," and may reiterate our commendation in connection with his more recent volume now before us. His chapters on the aphis contain much that is as astonishing as it will be novel to many of his readers; while he treats in a manner which will command equal interest of such pests as the wireworm, the weevil, the turnip-flea, the saw-fly, the clothes-moth, the scale-insect, the bed bug and flea, and the daddy-long-legs. This is a book to be bought by every dweller beyond the sound of Bow Bells.

First Year of Scientific Knowledge. By Paul Bert. Translated by Josephine Clayton (Madame Paul Bert). (London: Relfe Brothers. 1885.)—The charm inherent in all the best French popular scientific teaching has not evaporated. In Madame Bert's translation of the really admirable little book whose title heads this notice, Natural History (including Mineralogy), Physics, Chemistry, and Animal and Vegetable Physiology are discussed and expounded in a colloquial style, which at once arrests attention. If Science is to be generally taught in elementary schools, it would seem difficult to improve upon M. Bert's volume, in its English dress, as a primer.

* "*Omnes omnia*" says an old fellow, Simo, or the like, in Terence (his "Andria" I think), "*bona dicere, et laudare,* &c., &c. ("Hallyards" will say he *knows* I know no more of the quotation, if I don't finish it, so I go on to say that the old chap speaks of his *gnatum* (*qui gnatum haberem* he says of himself, *tali ingenio præditum,*—as near as I can recollect) though the son had not been behaving "quite according" (bad grammar, "Hallyards," but I know better, indeed I do). Still the infinitives, *here*, are easily understood. No one could make *abutere* an infinitive.

Alpine Winter in its Medical Aspects. By A. Tucker Wise, M.D., L.R.C.P., &c. Second Edition. (London: J. & A. Churchill. 1885.)—This is the second edition of Dr. Wise's "Alpine Winter Cure," of which we were able to speak favourably on p. 346 of Vol. VI. A considerable amount of additional information will be found in it, and its perusal may be commended to all who suffer from incipient phthisis or "a weak chest."

Practical Chemistry, with Notes and Questions on Theoretical Chemistry. By William Ripper. Second Edition. (London: Wm. Isbister. 1885.)—Professedly "adapted to the revised syllabus of the Science and Art Department for the elementary stage of Inorganic Chemistry," Mr. Ripper's work is worthy of more attention than that generally accorded to a mere cram book. Both the practical and theoretical portion of it seem well and honestly done.

French Course, by G. H. Williams, M.A. *How to Teach Reading*, by T. J. Livesey. *The Art Student's Second Grade Practical Geometry*, by John Lowres, revised by George Brown. *Poetry for Recitation.* Parts I., II., III., and IV. (London: Moffat & Paige).—These educational books are all good of their kind. The "Practical Geometry," in particular, seems well adapted to its purpose.

What is a Lady? (London: Griffith, Farran, Okeden, & Welsh. 1885.)—In days when we may see advertisements that "A young lady wishes a situation in a baker's shop," the question put in the title of this *brochure* may seem not to admit of any very immediate or definite reply; but it will be safe to say that the woman who will fulfil the requirements, and obey the precepts of its anonymous authoress, cannot fail to be recognised as a lady in the best and truest sense of that much-abused word.

Heart or Brain?—By the author of "Before I Began to Speak." (London: Fleet Printing Works.)—Forty mortal pages does this anonymous author devote to showing that it is the brain and not the heart which is the seat of affections and desires! It would pay him handsomely to show at, say, a shilling a head, educated people now-a-days who really think that their mental impulses come from a muscular force-pump.

As it was Written.—By Sidney Luska. (London: Cassell & Co.)—Mr. Luska's astonishing novel suggests the idea that it is the hurriedly-written morning's record of a nightmare incident on a heavy supper of underdone pork-chops.

Sheet of Maps to Illustrate the Caroline Islands dispute between Germany and Spain. (London and Edinburgh: W. & A. K. Johnston. 1885.) Engraved with admirable clearness, this capital sheet of maps should be obtained by everybody interested in the question of the sovereignty of the Caroline Islands. Its value is greatly in excess of its moderate price.

We have also on our table, *The Kansas City Review*, *At Home Among the Atoms*, *The Child's Pictorial*, *Progress.* From the Messrs. Cassell: *Cassell's Household Guide*, *Cassell's Popular Gardening*, *Library of English Literature*, *The Countries of the World*, *Our Own Country*, *The Book of Health*, and *European Butterflies* (as beautiful as ever). *The Seventh Annual Report of the Dulwich College Scientific Society*, *India's Interest in the British Ballot-box*, *Howard Association Report*, *Oct.* 1, 1885, *The Sanitary News*, *Electricité*, *Le Franklin*, *Naturen*, *Religious Opinion*, and the *American Druggist*.

THE FACE OF THE SKY.

From Oct. 23 to Nov. 6.

By F.R.A.S.

The Sun may be watched as usual for spots and faculæ. The face of the night sky will be found delineated on Maps X. and XI. of "The Stars in their Seasons." Minima of Algol will occur on October 25 at 7h. 3m. p.m. Mercury is an evening star, but is in no legitimate sense visible—a remark which applies, *à fortiori*, to Venus with his tremendous south declination. Mars, as a small, red gibbous disc, may be seen over the eastern horizon now after midnight, but as his diameter is only between 6″ and 7″, of course no detail can be made out on his surface. Forming a triangle with Regulus and μ Leoni to-night, he passes between these stars and to the east of Regulus by the end of the fortnight. Jupiter and Uranus are still invisible. Saturn is nightly coming into a better position. He still forms a triangle with ϵ and ν Geminorum. Neptune must be sought in the place so repeatedly described here recently. The Moon is full to-night at 9h. 22·6m., and enters her last quarter at 5h. 57·8m. p.m. on the 30th. She will be new on November 6 at 9h. 2·7m. p.m. Two occultations will occur during our prescribed hours in the course of the next fortnight. On October 27, B.A.C. 1930, a star of the 6½th magnitude, will disappear at the Moon's bright limb at midnight at an angle of 51° from her vertex. It will reappear at 1h. 6m. the next morning at the dark limb at an angle from her vertex of 249°. On the 29th, I Cancri a 6th magnitude star, will disappear at the Moon's bright limb at 10h. 5m. p.m., at a vertical angle of 115°; to reappear at her dark limb at 10 h. 26 m. at an angle of 164° from her vertex. When these notes begin the Moon is in Pisces, but at 4 o'clock this afternoon she passes into the north-west corner of Cetus. She quits this for Aries at 5 a.m. to-morrow, and remains in Aries until 8 a.m. on the 25th, when she crosses the boundary into Taurus. Travelling through the last-named constellation she arrives at 8 h. 30 m. p.m. on the 27th on the confines of the extreme northern projecting region of Orion. At 8 a.m. on the 28th she emerges from the other side of this in Gemini; whence, at 11 p.m. on the 29th, she passes into Cancer. At 11 a.m. on the 31st she quits Cancer for Leo, in her passage through which she descends at 9 p.m. on November 1st into Sextans; emerging however in Leo again at 1 o'clock the next morning. She finally leaves Leo for Virgo at 1 a.m. on the 3rd, and occupies until 3 h. 30 m. a.m. on the 6th in crossing the last-named constellation. Then she enters Libra, where we leave her.

Miscellanea.

A copy of the new Library Map of the Colony of Victoria has been forwarded by the publisher, Mr. A. Johnston, of 6, Paternoster-buildings, E.C., to the Queen who has been pleased, we may reasonably assume, to accept the present.

Messrs Bolckow, Vaughan, & Co., have come upon a thick bed of salt at their bore-hole near Eston Jetty, to the east of Middlesbrough. The salt was reached at a depth of 1,550 ft., and already 62 ft. have been pierced through without reaching the bottom of the bed.

Extensive fires have been wasting thousands of acres of wheat lands in Dakota. On many large farms all the buildings have been destroyed. These fires have raged during two weeks for hundreds of miles along the Northern Pacific Railway, from Brainard westward beyond Bismarck.

The Diamond Fields.—It appears that the production of the South African diamond fields in July was, in round figures, 170,000 carats, which realised £156,000, or 18s. 5d. per carat. In October, 1882, the production was 211,746 carats, which realised £355,315, or 33s. 7d. per carat. The reduction in the monthly production and the selling price has not, upon the whole, been so great as appears from this comparison, as the output has fluctuated a good deal from month to month; nevertheless, the general tendency of the selling price appears to be downwards, and the production has also been effected by serious falls of reef. It took the various diamond mines of the world two centuries, prior to 1870, to produce less diamonds than the Kimberley district has placed upon the markets during the last fifteen years. In view of this fact, and in view also of the gradual decline in the selling price, the conviction is forced upon us that the South African diamond fields have been permitted to produce too rapidly. The existing state of affairs is forcing amalgamation upon the various South African diamond mining companies; this may have the effect of decreasing the output, but it is believed that the diamond trade will ultimately be brought into a healthier condition by it.—*Engineering.*

"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office,* 74, *Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

The Editor is not responsible for the opinions of correspondents.

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

No communications are answered by post, even though stamped and directed envelope be enclosed.

ARE PLANTS SENTIENT BEINGS?

[1954]—Many years ago I satisfied myself that trees were aware of the attraction of gravitation, and exhibited their knowledge by not growing at right angles to the ground on the hillside as they do on the plain.

The pandanus, which has a creeping stem, throws downwards buttress roots as supports, and, as a remarkable illustration, a banian growing on the edge of a gorge threw down great supporting roots to save itself from precipitation into the depth below.

Each of these plants must have been aware of the riskiness of its position, in taking steps to secure its safety.

Plants are aware of injuries to their structure, and take early steps to repair them. Gash any tree, and it will at once, but slowly, set about repairing the mischief. Gash the pandanus, and it will inevitably develop a root at the spot. I may here note a singular affinity in the reparation of injury between the pandanus and our common house-lizard, the gecko. The facility with which it drops its tail, and its unconcern at the loss, are well known; but not the strange fact I am about to describe. One day I noticed on the wall a lizard with two tails; drawing nigh, quietly, I saw that the new tail had been pushed out on the scar of an injury, and Fig. 1 shows the curious result. Apropos to tail-dropping, the new tail is always smaller than the old.

Fig. 1.

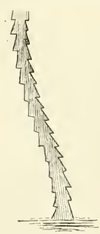


Fig. 2.

Let us return to the plants. The following fact shows that they must be endowed with something approaching sight or smell, or very exalted touch. Train a creeper up a three-foot pole, and let it run six inches above and throw out exploring tendrils; now erect another pole two inches beyond the possible reach of the tendril, and then mark how soon the new pole is seized; you will be astonished how soon the new support is recognised, and appropriated. What guided that plant?

Again, all plants are aware of the difference between darkness and light, and every one is familiar with the blanching effects of darkness upon vegetables; ... also with the fact that plants in verandahs grow towards the light.

Further, plants are distinctly cognisant of pain; out here, the date-palm (*Phœnix dactylifera*), as soon as it rises three or four feet above the soil, has to undergo the cruel process of tapping for toddy; a huge triangular gash is made into the soft structure beneath the crown of leaves, which distinctly retreats from the wound; next year, the poor tree is tapped on the opposite side, beneath the year's growth, and it retreats helplessly to the opposite side, and thus, as it advances towards old age, its graceful stem is converted into a jagged zig-zag (Fig. 2).

This serration is entirely due to the poor plant edging away from the cruel knife. An equally familiar illustration of the sensibility of plants to pain or irritation is seen in the common sensitive plant (*Mimosa sensitiva*) which shrinks nervously from the faintest touch, or even breath.

Then there is the well-known irritability of Venus' fly-trap, associated with its alleged carnivorous tendencies. These are also attributed to the sticky and humble *Drosera*, or sun-dew.

That the capture of insects by both plants is simply accidental, and in no way contributory to their sustenance, is easily proved by keeping them under glass shades, where they are as vigorous as when at large in the hothouse.

All plants are, more or less, sensible to bad odours or irritant fumes, and in their presence the *Mimosa sensitiva* shuts up shop at once.

All plants are equally sensitive to hunger and thirst, and heat and cold; all breathe, and all sleep; some visibly, as in the closing leaf or flower.

I used to be told at school that trees at home shed their leaves on the approach of winter because the increasing cold drove inwards the sap, and the leaves thus deprived of their life-blood dropped off.

Against this theory may be urged the fact that, in India, trees cast their leaves at the commencement of the hot weather, when the tree is laden with sap. In my humble opinion, leaf-shedding is simply analogous to moulting among birds; perhaps also to skin-shedding among reptiles and larvæ. Some plants, of weak intellect, exhibit it in apparently senseless movements. The leaves of a plant in Bengal (I forget its name and am away from my books) are in eternal agitation; and we are all familiar with the shivering of the aspen.

The sexual and seed-distributing movements of plants are very wonderful, and clearly indicate design; a common plant out here produces seeds like a hawk's skull, and, in the place of the ears, are two sharp hooks, which ruthlessly attach themselves to any passer-by. The irritable seed-pods of certain plants—the balsam, for instance, are familiar to all gardeners, and are clearly indicative of design in widely distributing the seeds. Nay, there is as much design in the spear-grass, which sticks its barb into the trouser of a passer-by, as in the bot-fly, which deposits its egg within reach of the tongue of its victim; or in the cuckoo, which drops its egg in the nest of the hedge-sparrow.

All plants have periodic œstra, distinguished in some by regular discharges; some of the acacias discharge gum; the cannabis indica discharges its gum-resin in the shape of charas, a most intoxicating drug.

The babool (*Acacia Arabica*) not only discharges gum arabic, but also takes on a coloured discharge of liquid catechu. The neem tree discharges profusely at times, and the discharge is regarded as very "big medicine" by the natives.

Plants have distinct instinctive powers, as I have already hinted at. What can be more remarkable than the invariable twisting from left to right of climbing plants. Why do they act thus? I can't say, unless they are flung to the right by the revolving earth.

Self-preservation and propagation are surely sentient principles, and both depend on the marvellous inherent vitality of plants. I will defy anyone to kill outright two of our figs: the banian, and the peepal: history tells us of the prodigious and combined efforts to destroy John Barleycorn, notwithstanding which

> John Barleycorn came up again
> And sore surprised them all.

And so, with all our efforts to destroy these figs. Let me explain: the peepal produces small round red figs, in thousands, and when they are in season, all the frugivorous birds of the neighbourhood flock to the feast by day, and the flying foxes (great frugivorous bats) by night. This seems simple enough. But mark the wonderful working of nature for sowing the peepal broadcast over the land. Its little seeds are indigestible, and pass rapidly through bird and bat. Consequently, wherever the dropping falls, there the peepal rises. And this means a good deal, when it is borne in mind that the peepal is the iconoclast of India, its great function being the disintegration of rocks and buildings. As regards the latter, it is a fearful nuisance, and the keepers of our great buildings—the Taj, for instance—are constantly on the watch during fig-time for bird-droppings.

As an illustration of what can be done, as also of the marvellous inherent vitality of the peepal, note the following: on the summit of the northern minaret of the great mosque of Bareilly, 150 feet high, a peepal flourishes grandly beyond reach of man; oxygen it can get freely enough from the surrounding air, from whence also it can get moisture during the rains; but how during the burning west winds of March-May? it flourishes all the same, and its ever-active roots are gradually destroying the cupola of the minaret.

We can hardly give the humble potato much credit for sentiency, yet that humble tuber knows very well what it is about. At home the whole tuber is cut up for planting; out here it tells us :—"Give congenial soil, and you need only plant my eyes, retaining my body for your food."

I saw this exemplified at Darjiling, where potatoes flourish marvellously, and where I saw the peelings of my kitchen growing freely in the ditch into which they had been cast.

If this hint were taken at home, what an enormous saving of food there would be.

I trust that after the facts I have adduced, an answer in the affirmative will be conceded to the question at the head of my paper. R. F. HUTCHINSON, M.D.

Pachmari, Sept. 12, 1885.

"THE PROCESS OF THE SUNS."

[1955] In your editorial comment to my letter (1592) you write, "These stars, however, always 'go in' again. How about that?" Well! according to present notions, our sun, and all other suns, after being born, "coming out," and attaining their grand climacterics of activity will gradually decline and "go in" again. Now, may it not be possible that amongst the suns there may be *fast* suns as well as *slow* suns? May not there be prodigal suns, which rush to their culmination and as quickly disappear? May there not be, in fact, differences in the periods of the evolution and devolution of suns? And may not the Star in Andromeda be a fast star? I trust, sir, that both you and the readers of this journal will perfectly understand that I am merely offering speculative suggestions.—W. CAVE THOMAS.

[I do not say nay. As the Frenchman said to Dickens, many things are possible. R. P.]

AUDEOGRAPHY.

[1956] I thank you for your notice of my little book. But when you liken my system to "diagrams of seagulls in flight, flydirt on windows, and worms which have been trodden on," you condemn shorthand from its very initiation. I merely follow in the footsteps of my predecessors in the use of straight lines, curves, circles, semicircles, and quarter-circles; I only differ in the application of these stereotyped shorthand characters. DIGAMMA.

P.S.—I have not the pleasure of knowing Mr. J. Greevz Fisher or his writings. [Nor have I. Did not the reviewer, though, say just what you do about the application of his remark? I fancy I recall something of the sort. I have not seen your book.—R. P.]

TO GET THE FLESH OFF A MOUSE.

[1957]—Reply to "Nigel's" query, current number of KNOWLEDGE, p. 300. To get the flesh entirely off a mouse.—Having set him out in a good attitude, bury him very lightly beside an ant's nest. Beautiful preparations of small skeletons are made in this way. X.

HOW TRADESMEN CALCULATE PERCENTAGES.

[1958]—It appears to me that a brief criticism in KNOWLEDGE of the mode in which London tradesmen calculate their percentage of profit would have a salutary effect.

The following declaration of faith (so to speak) is that of an intelligent traveller for an important trading concern in London, and is supported by the opinion of one of the most extensive tradesmen in the metropolis. I give the statement word for word.

"If I purchase an article for 10s. and sell it for £100, I assert that I get a profit of 99½ per cent. exactly on the transaction."

I am informed that London tradesmen consider any other mode of calculating profits misleading. I will thank you for an authoritative expression of your views.

I enclose my card, but not for publication, and sign myself,

DER EWIGE JUDE.

[Emphatically this is *not* a *method of calculation*, unless adding 2 to 2, and getting (say) 81, may be so regarded. The profit is of course not 99½, but 19,900 per cent.: a slight difference. What the tradesman really means, and wants to say, is that of his selling price, in such a case, 99½ per cent. is clear profit. But of course that is a very different thing from "the percentage of profit on the transaction."—R. P.]

LETTERS RECEIVED AND SHORT ANSWERS.

IRIS. The book is bosh—utter and irredeemable.—ROMEO. "Alas, you thought it could be trusted, but though you tightly tied it down, it busted" quotation is from *Punch*—very venerable, fine old crusted. It busted about the delicate neck of it, and no experiment could be made.—G. J. W. LOCK. Fear there is no space.—J. W. GREEN. We have been obliged to discontinue putting in any poetry; it gets so misunderstood. We cannot, for that reason, even give reasons.—CHEMICUS. Lockyer on Spectrum Analysis and Lockyer on Astronomy are different matters. He is reputed to be a chemist among astronomers. But I cannot answer for that point. You can safely try Roscoe's. Still I believe Lockyer's is sound.—B. On first question, I have no knowledge of such a work. On the second, I propose to answer that in the way you suggest as best. Thanks for pleasant letter.—F. W. H. Yes: but don't mention it. Even of the best of that sort, we can only say "They mean well; oh! they mean really very well: but——they don't know." R. LEWINS. *Quien sabe?* HALLYARDS. As I have said to others, so say I to you; I adapt my answers to those I am addressing. If you have seen answers that "made you wince," be sure I was responding to great rudeness. Your last letter singularly illustrates your callousness towards me; why should I be less callous towards you? Why should I suppose you will feel at all hurt if I answer in kind? That would be to attribute more wilful offence to you, than you have (I imagine) been guilty of. I have politely assumed that it is because a little plain speaking does not hurt you that you are so very free with it towards me. For instance, in your letter of four short pages, quite up to your usual average of courtesy, you tell me in the first page that I say the thing that is not. (Thus satisfying yourself that I am very ignorant.) And again you charge me with untruth (about your comparative ebriety letter) in the second page; on the second page, also, you sneer at my work as editor, and call me in effect a bad man of business; on the third page you call me a sophist and a savage; on the fourth page you call me a bear, and even provide an epigram for me (you say you "have made" it, but that must be a slip of the pen considering the antiquity of most of it) as follows:—

> Quà locus, Erigonen inter, Chelasque sequentes
> Cæsaris, eu! functi nnmina fixa polo.
> Quàque micant Ursæ, metuentes æquore tingi,
> Astrologus Cæsar Maximus Ursus erit.

Adding such "praise to the face" as—known to be unmerited—is assuredly "open disgrace." If I take all this as "banter," you should take my replies in kind.—(I win the brass farthing, by the way.) I wrote *patientia* (uncircumflexed, as usual), and I wrote *abuti*; but every one knows the original passage, and I suppose a "printers' reader" who knew it thought there was something wrong, and altered *abuti* to *abutere* as in the original passage, and the *supposed* nominative into an accusative. I ought perhaps to say that I *certainly* meant to write *abuti*, and *to the best of my belief* did so write the word; but after the tricks I have known the mind play (me and others) I could not be absolutely sure that I wrote what I meant to write. (This very moment I wrote *abutere*, where, just above, I intended to write *abuti*.) As for the *patientiam*, I am satisfied I did *not* write that, because there was nothing to lead the mind to such a mistake. Most likely the absence of the circumflex led the "reader" to correct what he thought an error. A look at the MS. might explain—some mark looking like an "m" and belonging to another line, might have deceived the compositor or the reader. You are probably not aware that "readers" often suggest corrections (in French this repeatedly happens), and where notes like my replies, hurriedly jotted down in pencil (nine-tenths written in express trains as well as at express speed), and set up usually without my seeing proofs, are in question, a "reader" would not hesitate to correct to the best of his judgment what seemed wrong, especially if the writing were not easily decipherable. No one *could* do what you, "an experienced examiner," attribute to me. How on earth could the verb be infinitive in the sentence—"Quo usque tandem abutere, Catilina, patientia nostra"? followed as nearly as I can recall the words by "quam diu nos etiam furor iste tuus *eludet*? quem ad finem sese effrenata *jactabit* audacia?" One might as reasonably find an infinitive in the familiar . . . . *si non, his utere mecum* (though following the imperative *imperti*: of course here the quantity shows that the word is imperative, not future indicative. If you could not credit me with a schoolboy's knowledge of Latin, of the "Fungor, fruor, utor, vescor," &c., rule, of Cicero's fondness for the termination in *re*, and like details ("worth a pignut," anyway) you might at least give me credit for some small modicum of common sense. Surely you have shown here "the savage desire to make me contemptible," &c., which you attribute to me,—a perfect lamb, Mr. Wolf!—The answer which shocked you so related to manners, not to morals. A man applies to a woman in these columns the grossest term one can well think of (not actually using the word, but sending readers to "Othello" to find and apply it, which was rather worse), and

because I am indignant, you talk about Antinomian principles, and I know not what. I did well to be angry. (My anger was purely on principle; for personally I did not care two straws about the matter.) As for weekly KNOWLEDGE, and your idea that it does not (or rather did not) pay, it certainly did not pay me—nothing would, I think—for the worry and annoyance of the Replies Column, or even for the work involved. I value at about ten pounds weekly the time given to this. Do you suppose it paid me at that rate!—P. J. BEVERIDGE. No: no offence, but wasting time. I certainly understood your use of the word "infinitesimal" to mean (as mathematicians use it) something indefinitely small. Nothing "virulent or insolent" in your remark about my supposed mistake; you tried my *patientiam* only in the sense of trying the *word*, not my patience. What an odd mistake your idea that I referred to *you* when in replying to "Hallyards" I spoke of a "reader" ("inverted" to show I meant the word in its technical sense), going to look up the passage in question. I meant, of course, the "printer's reader." When I was quite a little chap I knew that oration by heart—and I know it pretty well by heart now, but a minute or two ago I found myself in doubt about "nos" in the second sentence. I remember I learned it so young that, being by myself, with no one to tell me how to pronounce, I got a number of pronunciations wrong, including the first words, which I read Quowsqwy (almost rhyming with "house key") greatly to the astonishment of the master who first heard me say it—when I was about 12, and ought to have known better. (In like manner, even to this day, if I say off the letters of the Greek alphabet without attending—as people repeat the Creed and the Lord's Prayer—I always finish off, Fy, *Tehy*, Psy, Omega: if "Hallyards" heard me say that, he would be sure that I pronounced Achilles, *Atchilles;* but I don't. I have a son who in like manner learned to recite the Creed with this remarkable emendation,—"Suffered under Punch's spider," and would say it so now if not attending. A valued contributor to these pages learned, in his catechism, about "the sea and all the Tinthummies," forming vague ideas (like Pip about "jiggering" and De Morgan about "vicktchuals") as to the nature of these presumably pelagic creatures. Of course "utor" without "ab" governs the ablative. I have a vague recollection of the rule about this, in that preposterous work the Eton Latin Grammar, coming soon after one of the few rules I recall of all that rubbish, to wit, *Dativum ferme regunt* [don't they] *verba composita cum his adverbiis, bene, satis, male* [as "*Dii tibi malefaciant*"—a cheerful thing to teach a boy to say] *et cum his præpositionibus* [almost as nice as "Mesopotamia"] *præ, ad, con, sub, ante, post, ob, in, inter.* I wonder whether anything half so idiotic as teaching boys this (instead of teaching them to read and speak Latin and so to find out those rules) goes on at any of our schools now. I can read my Horace or my Terence; but I assuredly did not learn to understand Latin or enjoy reading it, at school, or at college either: and I anathematise in my inmost soul, the idiots who devised the Eton Grammar method (there's madness in the method). Here endeth the Replies Column.

Our Chess Column.

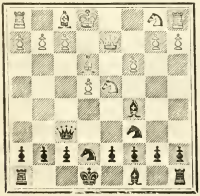
BY MEPHISTO.

Dublin, *Oct.* 5.

DEAR SIR,—I have studied with interest your games, &c., on the Scotch Gambit Opening, in which White plays 7. Q to Q2. As you are desirous of having some games on the subject, I send the opening of a few of my own, also of two played between the Rev. G. A. McDonnell and Mr. Jas. Alex. Rynd, during the visit of the former to Dublin.

W. H. S. MONCK.

WHITE.

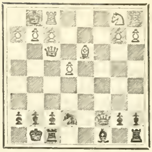


BLACK.

White. Mr. G. North	Black. Mr. Monck
7.	P to Q4
8. Kt to Kt5	B × B
9. Q × B	Castles
10. Kt × P	P to Q5
11. P × P	Kt × P
12. B to Q3	Q to QKt3
13. Castles	Kt to B6 (ch)
14. Q × Kt	Q × Kt

I do not think that Black has sufficient compensation for the P, though I won the game ultimately.

WHITE.

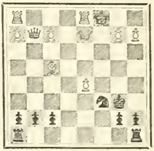


BLACK.

White. Mr. Monck.	Black. Mr. T. Pierce.
7.	B × Kt
8. P × B	P to Q4
9. Kt to B3	B to K3
10. B to QKt5 (B to Q3 seems better)	Q to Kt3
11. B × Kt (ch) (an unsound combination)	Kt × B
12. P × P	B × P?
13. Kt × B	Q × P
14. Kt × P (ch)	K to Q2
15. Castles	K × Kt
16. B to B4 (ch)	K to Kt3?

17. P to Q5 winning Kt with Q, for White threatens to check at K3, and then play one of the Rooks to KKt sq.

WHITE.



BLACK.

White. Mr. Rynd.	Black. Mr. McDonnell.
7.	Castles
8. Kt to Kt5	B × B
9. Q × B (White can also play P × B here with good effect)	P to Q4
10. Kt × P	R to Kt sq.
11. P × P	Kt to B4
12. Q to KB4	P to KKt4
13. Q to K4	B to Q2
14. Q to B2 (If 14. P × Kt, B × P, Black would soon regain the piece with a good attack.)	Q to K4 (ch)
15. B to K2	QKt to K2
16. Kt to R3	Q × Kt

Here, I think, Black has the advantage, but White (?) won.

WHITE.

BLACK.

White. Mr. Rynd.	Black. Mr. McDonnell.
7.	Q to Kt3
8. P to B3!	Castles
9. B to Q3	Kt to K4
10. Castles	P to Q4
11. Kt to R3	B to R6!
12. R to B2	QR to Q sq.
13. QR to Q sq.	B × KKt
14. P × B	B × P!
15. R × B	Kt × P (ch)
16. K to R sq.	Kt × Q
17. R × Q	BP × R
18. R × Kt	R to B6

I prefer Black, but White won.

WHITE.

BLACK.

We are much obliged to Mr. Monck for the above games, and hope to continue our investigations in that direction.

Our Whist Column.

By "Five of Clubs." *

We come next to the painful subject of the revoke. This, so far as my observation has extended, is a commoner fault in club play than in home play: probably because in the kind of Home Whist which I wish to promote, there is a love of the game which renders revoking almost impossible. Among club players there are always some who are no real lovers of Whist, but chiefly love to play because of the excitement which the chances of the game afford. Of course, in club play, the penalty for the revoke—three tricks to be taken from the score of the revoking side, or added to the score of the other side, or to be partly taken from the former and partly added to the latter—is remorselessly exacted. But in Home Whist the case is different. Here, if the revoke can be corrected (the penalty is due, be it remembered, when the revoking trick has been turned and quitted), without harm to either side, this should be done. If the revoke, though it can be corrected, has affected the strategy of the game, then the other side may properly claim the right to call the cards played in error, or to call a suit. But if, as often happens, the revoke is detected too late for correction, and it is impossible to determine what its actual effect may have been, it is a good plan to deal thus with the score (which, as will presently be shown, is to be kept systematically in Home Whist):—Subtract three from the score of the revoking player, and one from the score of his partner. This puts the chief loss on the revoker, but properly inflicts a loss on his partner, because in most cases a trick is gained wrongfully by a revoke. Sometimes, of course, more than a trick is gained, and sometimes nothing; but what amounts in effect to a gain of two by each of the non-revokers, met by a loss of three by the actual revoker, and of one by his partner, is a very fair average compensation for the effects of a revoke.

Lastly, so far as the Whist code is concerned, let home players, if they wish to play a decent game, and avoid an annoying and mischievous practice, give up the privilege accorded by Law 91, that a player may demand to see the last trick turned, at any time before the current trick is turned and quitted. Let players of Home Whist determine that if, through inattention, they find themselves unable to remember the cards which fell to the last tricks, they will put up with the consequences, and play more carefully in future.

A few words here on the etiquette of Whist, which I regard as more important than even the laws, in the home game. Nothing more distinctly marks the true lover of the noble game of Whist than the care with which he avoids anything which can give his partner intimations not derivable from the actual progress of the play, and anything by which the adversaries may be wrongfully misled. The offences to be specially avoided are these:—

1. Looking gloomily at a bad hand, or the reverse.
2. Smiling complacently over a good one, or the reverse.
3. Expressing disapproval when partner does not lead as you wish.
4. Expressing approval when he does.
5. Pretending to hesitate when you have but one card you can play, or when you can have no doubt as to your play.
6. Showing by any movement that you know how a trick must fall, when you can only know this because you hold a particular card or cards.
7. Showing by any movement that your partner need not take a trick which you know (but he may not know) to be yours.
8. Looking at the opponents' cards.
9. Letting your own cards be visible.
10. Forgetting, or acting as if you had forgotten, that Whist is a game intended for relaxation and diversion.

With regard to the method of playing, I would make the following remarks:—It is well to keep a score, not for each evening's play only, but running on from day to day; and in this score the number of points made by each player should be entered, as also the number of revokes, exposed cards, and other like delinquencies: such a record has the effect of keeping the play strict and methodical, without the degrading tendencies which money stakes, however small, necessarily have. It it well to count only half honours in home play,—that is, one instead of two for three honours, and two instead of four for all the honours. Omitting to count honours at all eliminates still more the chance element, and is in my opinion better yet, considered by itself. But as players have often to be met who count honours, it is necessary to keep in the way of noting them: and in the long run the influence of chance in this matter equalises itself. For a similar reason, it is well to play for rubbers in the usual way—that is, counting a game made before the enemy has scored as three, before they have scored more than two as two, and when they have scored three or four as one, the rubber (or best of three games) counting as two. The system is absurd enough, doubtless, since the winners of the rubber may have scored fewer on two games than the losers on one. The Chilian system described in "How to Play Whist" is a far better one. But as you have often to play with those who know no other system than the club system—essentially a gambling one—it is as well to adopt it for home play. The undue effects of the rubber points are equal for all in the long run; moreover, pretty points of play often arise out of this method of scoring. (Note that tricks count before honours, so that if one side hold all four honours and would go out with them, but their adversaries go out in tricks, the honours are not counted at all; whereas, if one side go out in honours, and the other side, though not going out in tricks, make one or more, these must be counted, in determining whether a game is to be regarded as a single, a double, or a treble.

Lastly, be it noticed that when the full number of players cannot be brought together, single dummy is an excellent card game for three, and double dummy a capital game for two. Both games are slow and wearisome in the extreme when played, as they too often are, without attention to the principles of Whist strategy. But they are most interesting when played properly. Nothing tends more to improve the Whist-player than an occasional turn at dummy Whist.

* From the forthcoming little work on "Home Whist," by Richard A. Proctor.

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